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Electronics

AUSTRALIA WITH ETI

FEBRUARY 1995 $4.95*
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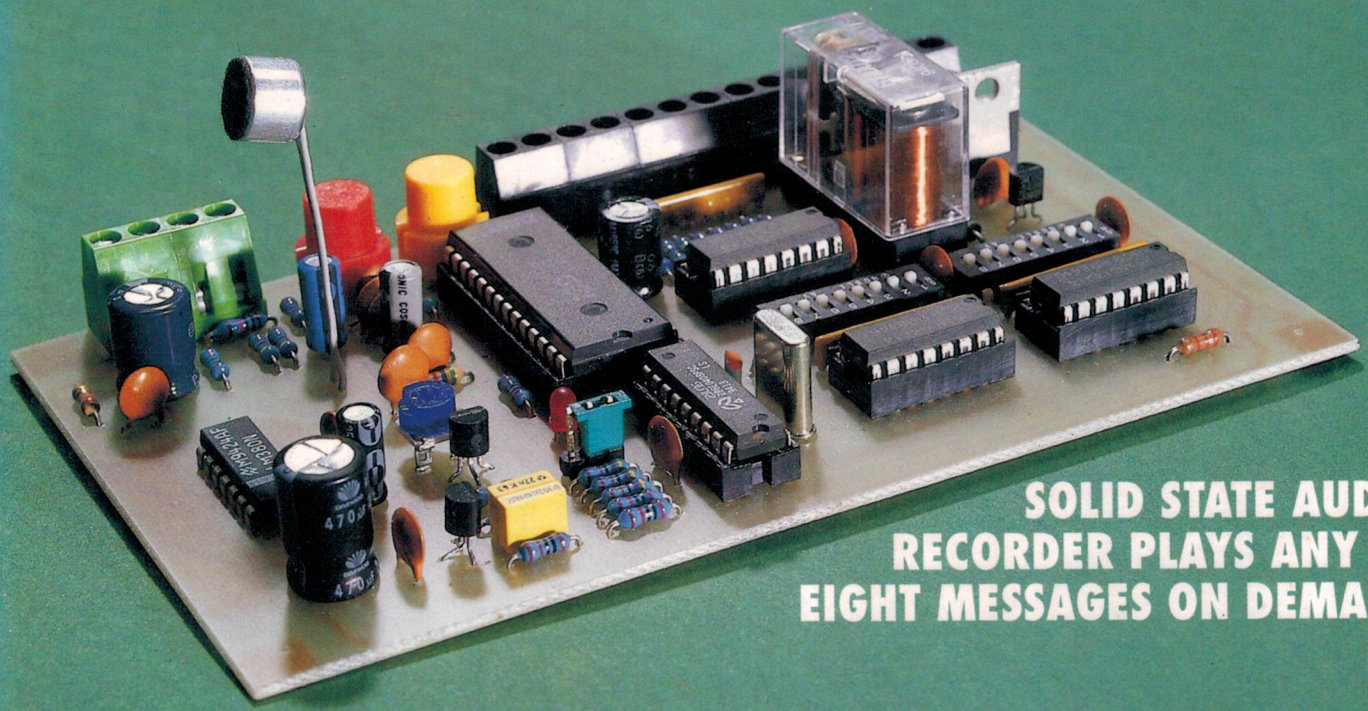

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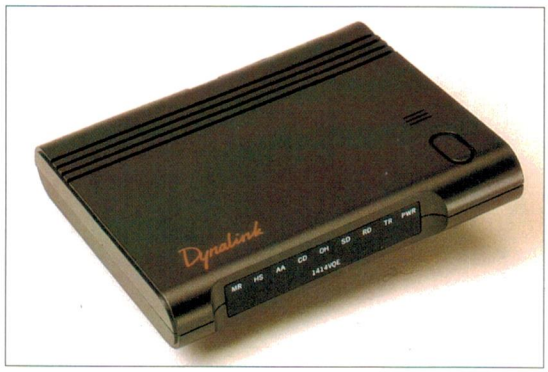

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Compatible with all industry-standard fax and communication programs.
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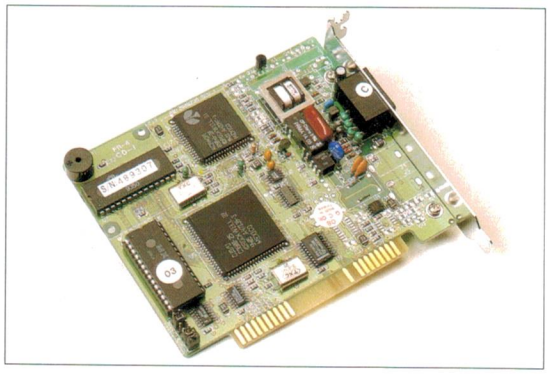

1414VQH

High-speed
IBM card fax modem
V.32bis (14.4 kps) data and fax modem.
Extra length (4.5m) phone cable.
Configurable as COM1-COM4.
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Compatible with all industry-standard fax and communication programs.
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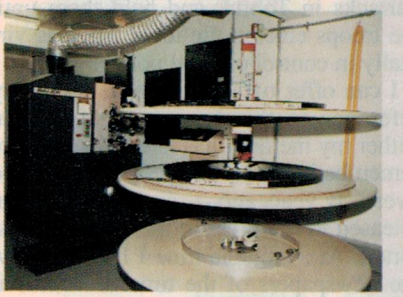
Electronics AUSTRALIA WITH ETI

Volume 57, No.2
February 1995

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

Hi-tech in a modern cinema



Electronics and computer control have brought about dramatic changes inside the projection box of modern 'multiplex' cinemas. Projectionist Reg Leahy explains how it all works, in his article starting on page 20...

Interactive satellite TV

Victoria's schools are now able to offer both students and teachers the benefits of interactive satellite TV training, via the state's ISTV network. Melbourne Satellites installed many of the terminals, and also three systems for the Army's College of TAFE in Bonegilla — see page 32.

On the cover

The upper photo shows Bob Parker's novel VMAC module, which lets you record up to eight short messages and play any one back in response to a digital signal (see page 56). Also shown is Paris Radio's automatic house number project (see page 82). Photos by Ben Granger.

Video and Audio

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Projects and Technical

Professional Electronics

Columns and Comments

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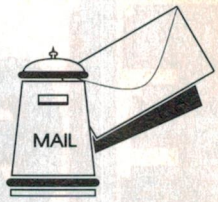
LETTERS TO THE EDITOR



Electronic mail

I have been a reader of your magazine since 1982 and would like to make a suggestion concerning the 'Letters to the Editor' section of your magazine.

How about opening an e-mail address?

With computers becoming more commonplace every day, I'm sure many of your readers would have access to (if not possess) some form of electronic mail service, whether this be via CompuServe, Oz-Email, Internet, etc.

As there is a significant delay in the publishing process of a monthly magazine, would not e-mail enable readers to respond in a more timely manner to columns and articles?

On a different note, I would like to compliment you on what is generally a very professional and informative magazine. Also for keeping the cover price under that $5 'mental barrier'!

Paul Richter,
Latham, ACT.

Comment: Your point is well taken, Paul, and you'll find an announcement on page 106 of this issue.

Kingsley Radio

I wish to take this opportunity of thanking Electronics Australia and Neville Williams for publishing the story of Howard Kingsley Love, of Kingsley Radio fame where I learnt my profession. I am pleased that I was able to make some contribution to this.

However, I would like to supply some corrections and additional information. Firstly a small error crept in due to two people with the same Christian name. At the time of writing my story I could not remember the name of Tom Heywood's mate and referred to him as Laurie. At a later date I was reminded that it was Laurie Harris. The Laurie who came to work in the design laboratory was Laurie Buckingham, and Neville Williams inadvertently thought that they were one and the same. I hope that this corrects the record for Laurie Harris.

Belatedly I have been doing some research at the local library and *Air War Against Germany 1939-1943* by John Herington records in part '...that Bardia was captured 5th Jan. 1941' and '...on 14th Jan 1941 Corp. Jarvis wireless operator and L.A.C. J. Parr of 208 Squadron were out checking radio equipment with the artillery near Tobruk. Lost near Tobruk, Jarvis was filled and J.Parr captured. He was the only British prisoner in Tobruk. On 22nd Jan, 1941 Jack Parr took charge of the gendarmerie barracks in Tobruk and held them until the troops entered the town. He was virtually in control of local police.'

I can offer two explanations about my reference to this happening at Bardia. Either my memory has faltered — we are remembering something which happened over fifty years ago — or the information released to the press at the time was distorted. At a suitable time I hope to view the newspapers of the time. I wonder if there are any RAAF 208 Squadron or AIF 6th Division personnel who can shed any light on this event.

I have just read the *Official History of Australia in the War of 1914-1918 Vol. VIII Australian Flying Corps,* by F.M. Cutlack. On page 244, it states in part '...in the morning of April 10th 1918...'Lieutenant H.K. Love of No.4 Squadron '...also had to land in enemy territory, either wounded or with his machine damaged, and was taken prisoner. He was seen to land under control, but hit a fence, and his machine went over on its back.' This elaborates on what H.K. told me so many years ago and reassures my memory a bit.

Finally, by a strange set of circumstances I have made contact with H.K. Love's daughter Kathryn.

George Neilson, VK3TES,
Blairgowrie, Vic.

Commodore update

In the August issue's Silicon Valley Newsletter it was mentioned that Commodore International had gone out of business.

Although this is true, after it went into liquidation, it was bought out by Commodore UK. Commodore International was the division which was the most inefficient, and unfortunately, was in charge of US distribution and advertising. Now that Commodore UK has taken it over, the distribution of Amiga 1200 and 4000 (with 24-bit graphics and 8-bit sound built in) computers will continue as will development of the new generation of Amigas based on the 'AAA' chip-

set. These will feature Motorola 68040's and 68060's (80-100 MIPS) and in the future, a HP RISC CPU.

David Haynie, Senior Engineer at Commodore responsible for the new Amigas made comments earlier this year which indicated an aggregate bandwidth of 400 - 600Mb/sec as far as moving data around the system, and 16 bit sound with eight independent voices at sampling rates up to 64kHz. An AT&T 3210 Digital Signal Processor will be included, enabling fantastic sound and music effects as well as high speed modem emulation, speech recognition (built-in), high power image processing, etc.

All this coupled with a user friendly, Windows orientated pre-emptive multitasking Operating System (incidentally, Amigas have had such an OS since 1985, as well as technological advancements such as Local Bus), will make the Amigas stand even further out in the crowd of politically correct Mac's and laboriously slow IBM compat's.

In regard to your comment about Commodore failing to cut out a niche of its own, Amiga has quite a 'cult' following, if you go to an Amiga user group, you will meet some of the most devoted people in the computer industry, many of these people use IBM's at work and still swear by their Amigas. Also, on the Amiga Newsgroups on UseNET, you will see an immense number of devoted Amigans.

Joshua Pryor,
Belmont, NSW.

Etone speakers?

I would greatly appreciate your assistance with whatever information you can give me in the following matter.

I am trying to get hold of an 'Etone SW-250' subwoofer loudspeaker in good working order. This speaker was written up in your August 1982 (!) issue, headed '100W sub-woofer speaker enclosure'.

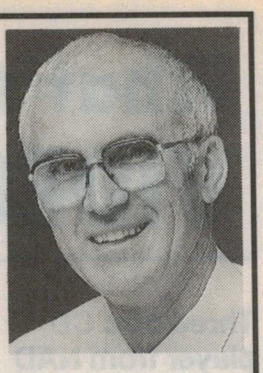
It would appear that Etone have either gone out of business, or been swallowed up by somebody.

At the same time, it is difficult to image that there wouldn't be one lying around in Australia, or in stock somewhere, which its owner would be willing to part with for a reasonable amount of money.

P. Gonda,
Linden Park, SA.

Letters published in this column express the opinions of the correspondents concerned, and do not necessarily reflect the opinions or policies of the staff or publisher of Electronics Australia. We reserve the right to edit letters which are very long or potentially defamatory.

EDITORIAL VIEWPOINT



Hobby enthusiasts make the best technicians and engineers!

When I was a teenager at high school, my friends and I were already keen electronics enthusiasts. Then when I left school and was lucky enough to get a job as an engineering trainee doing a degree course at night, most of my fellow trainees/students and I were still building hobby projects as well, in our 'spare time'. I can remember how strongly we competed to see who'd be first to get their TV receiver going — it was late 1957/early 1958, and almost all of the sets were based heavily on designs published in this magazine, as I recall...

Many of us went on to make our careers in electronics, and I think it's generally true to say that those who were the keenest hobby enthusiasts also seemed to end up as the most successful engineers. I've also found that whenever I've met other really successful scientists, engineers and technicians, more often than not they've also turned out to be keen hobby enthusiasts.

This general idea, that 'keen hobby enthusiasts make the best technicians and engineers' is one that I've often seen expressed by overseas magazine editors as well — so it must have at least a fair degree of validity. Yet lately, I've also seen and heard worrying comments like "Where have all the enthusiasts gone?" and "No-one seems interested in building things anymore..."

The other day I had the opportunity to talk to a Senior Lecturer in Electronics at one of the local universities, and I asked him what proportion of his students would also be hobbyists who had built up some projects, or at least a few kits. His estimate was "Only about two or three percent", and we both agreed that this didn't augur well for the future of Australia's electronics industry.

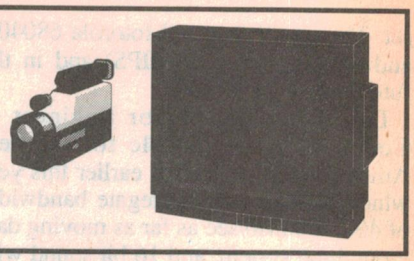
One can speculate at length about the reasons for this decline in hobby enthusiasm among young people. It seems likely that the growth of low cost personal computers has played a part, seducing away at least some potential electronics enthusiasts with the promise of exciting games, multimedia adventure and the glamour of programming. Perhaps TV broadcasting has contributed as well, by providing so much 'pre-digested' entertainment. But whatever the reason, I do believe it's important that the trend be reversed if at all possible.

Here at *EA* we're certainly making every effort to boost *our* output of interesting and affordable electronic project designs, in an effort to attract more young people back into experimenting with electronics. We've just added to our in-house staff a new project designer, Graham Cattley, to strengthen our capabilities in this respect. And I'm happy to note that like the rest of us, Graham is very much a long-time enthusiast who loves playing with electronic circuits and devices.

You'll be seeing Graham's designs in the magazine shortly, along with as many other projects as we can fit in. So how about warming up that soldering iron, and tackling a construction project *soon*. Building up circuits and getting them going is the best possible way to learn about electronics — that's WHY hobby enthusiasts make the best engineers and technicians!

Jim Rowe

What's New in VIDEO and AUDIO

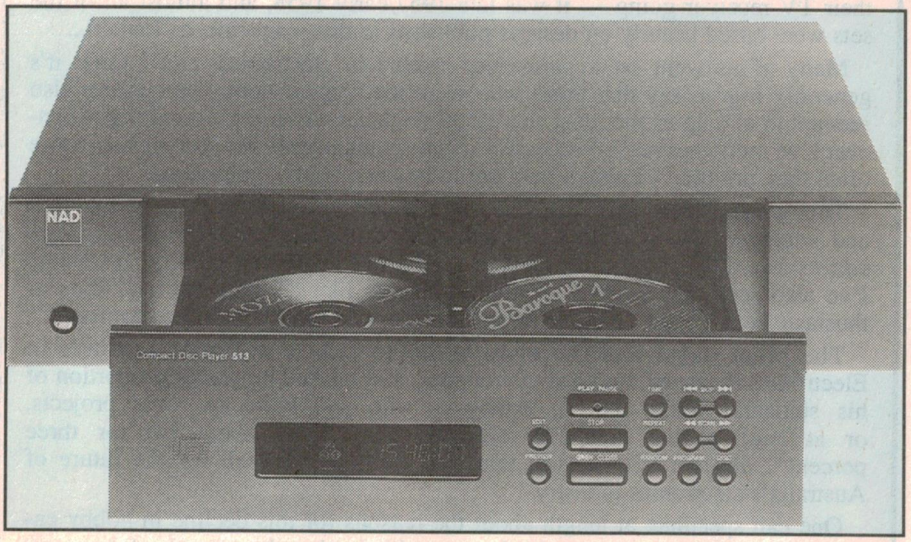


Three disc CD player from NAD

After careful market research, NAD apparently found that most people do not need to, nor even want to, play more than two or three CDs after one another, as the total playing time of three CDs can be as much as three hours and 45 minutes.

With this in mind, and by adhering to their philosophy of 'no bells and whistles', NAD engineers developed the NAD 513. By employing the carousel principle and limiting the number of discs it can hold to three, the mechanism could be built much simpler without sacrificing either performance, reliability or useful features. The end result is a fully fledged CD changer with the performance and price of a single disc CD player.

Like other NAD CD players, the 513 achieves transparent and precisely linear digital to analog decoding by employing a single-bit MASH circuit, while balanced filtering removes ultra-sonic by-products of the decoding process to ensure no intermodulation distortion without affecting the audio performance.



Despite its simplicity, the NAD 513 offers all the facilities normally associated with carousel CD changers — two discs may be changed while the third is playing; the remote control makes changing discs and selecting tracks easy without having to touch the front panel; the programming facility for 32 tracks over three discs makes track selection a breeze; and with the Random function engaged, all tracks from all three discs will be played without repetition.

The handy Edit function even helps to choose tracks to fit onto a side of a cassette without wasting tape or ending a track abruptly.

Dual returns to Australia

Dual, the highly respected German turntable manufacturer, has returned to the Australian market. The company that among many magnificent turntables, gave us the legendary CS-505, now presents a complete range of audio

Technics mini hifi

The new Technics SC-CA1060 mini hifi features sleek curves, clean lines and is claimed to deliver superb sound output. It is a full separate component system, consisting of an amplifier with phono input, a single CD player, double cassette deck and separate tuner.

The amplifier has 'New Class A' circuitry and large VU power meters which give a more accurate readout of signal levels. It features Virtual Battery Operation (VBO), which is a feature normally associated with top end amplifiers. VBO cuts off 'noise' from the main power supply to deliver richer, cleaner sound.

The single CD player has MASH and digital servo for improved sound reproduction, plus 24 step random access programming. The double cassette deck has dual auto-reverse, power loading and Dolby B/C NR. It also has high speed FF and REW and auto tape selector (Metal/CrO_2/Normal). CCRT (computer controlled record tuning) function tunes the deck to suit the brand/model of the cassette being used for optimum performance.

The stereo synthesiser tuner has 39 station random access presets and tuning job control. The three way speaker system

features a 14cm woofer, 8cm mica composite cone midrange, 2.5cm soft dome tweeter and a 'noise silence' speaker cabinet, delivering a power output of 40W x 2 (DIN).

The SC-CA1060 comes with a full remote control which operates all the functions of the system. It carries an RRP of $2749.

and video equipment. Dual has expanded into a full scale electronics supplier with separate hi-fi components, packaged mini and midi hi-fi systems, VCR's, a complete range of televisions and of course, a full line-up of 12 excellent turntables.

The fine reputation and strength of the Dual brand name has helped the company enormously to move into these exciting new fields in Europe, where it holds a considerable market share. At the same time Australia is experiencing a 'Euro-Invasion' as a variety of European cars compete head to head with Japanese cars, while German televisions are enjoying unprecedented sales.

With this emerging 'Euro' trend it was considered that now was the perfect time to relaunch the new look Dual and re-establish the marque in Australia. Distribution of Dual is via a joint effort between Melbourne based Scan Audio, a well established loudspeaker import/distributor, and Sydney based Indeco Sales, a newly established firm that also markets their own German made Indeco 'La Linea' hi-fi racks.

"We are very excited to be promoting electronics to compliment our loudspeaker business. Dual is the perfect European prestige brand" said Michael Henriksen, Managing Director of Scan Audio.

Large screen projection system

The new Electrohome ShowStar LCD Large Screen Projection System is designed to deliver high brightness images with uncompromising reliability for large venues including auditoriums, conference rooms, trade show exhibits, and lecture theatres.

ShowStar employs LCD projection technology and incorporates Electrohome's innovative light diffusion system to eliminate hot spots and provide brilliant, clear text and images with uniform brightness across the screen. ShowStar retains sharpness of image throughout a range of projection distances comparable to a conventional CRT projector, while operational lenses are available to facilitate long distance and placement flexibility.

The system features a striped configuration of its LCD pixels to produce the sharpest images possible. Each pixel is in exact alignment with its adjoining partner to each side, as well as top and bottom. The results are said to be remarkably better, particularly on fine text and vertical lines, than the staggered pixel configuration employed by competitive systems.

All functions are controlled by a convenient, back-lit remote keypad. Easy to follow menus and 'slide-bar' graphics allow adjustment of image functions including brightness, tint, contrast and colour saturation. ShowStar will display images from five to 25 feet (diagonal) in size, at a resolution of 640 x 480 or 550 TV lines.

Maximum usable brightness is 5000 peak (1000 ANSI) lumens, provided by a 575W Metal Halide arc lamp with 1000 hours average life expectancy. A change can be accomplished in under five minutes.

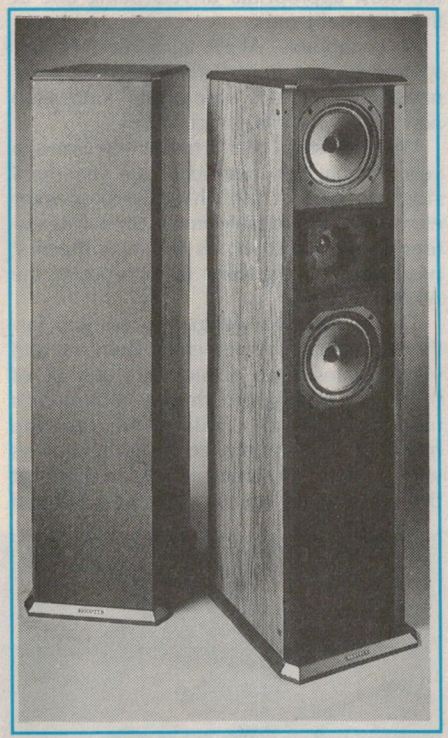
Separate inputs are provided for composite video and S-Video sources, and RGBHV computer sources. ShowStar is compatible with video clock rates from 13 to 33MHz, horizontal scan frequencies from 14 to 37kHz and vertical scan frequencies from 49 to 75Hz, interlaced and non-interlaced. ❖

New Classic Series loudspeaker from Duntech

Australian audiophile loudspeaker manufacturing company Duntech Audio has released its new Viceroy (C2000) loudspeaker.

According to Duntech Sales USA National Sales Manager Brian Tucker, the Viceroy is the product for consumers who have wanted the premium performance of a Duntech but were unable to afford previous models. "For less than $5000 our customers can enjoy many of the benefits of the legendary Duntech Classic Service such as 'walk in' stage depth and width and astonishing transparency."

The Viceroy is less than four feet high and barely over one square foot in plan. Its elegant lines reflect the styling of its bigger brothers and sisters, with styling elements to allow it to harmonise with homes in the 90's. It is designed around completely new drive units, and incorporates radical new High Definition Aerogel drive units.



The Viceroy has three drive units in a symmetrical array with two Bass/Mid units above and below the tweeter. The arrangement of drivers on the baffle, with the tweeter coincident with the acoustic centre of the Bass/Mids provides for the simultaneous arrival of sound at the listener distance of 12 feet. In addition the point source character of the microphones used to record music are recreated by the vertical layout of the drivers. The result of this is claimed to be remarkable stereo imaging, depth, dimensionality and detail.

The useful low frequency limit of the Viceroy is below 30Hz with in-room extension (-3dB at 40Hz), which is suitable for virtually any program matter, whether pure music or A/V and Home Theatre.

The sensitivity is 90dB SPL (2.83V at eight ohms and 1m). The impedance is four ohms, with a well behaved frequency characteristic. The loudspeaker is capable of huge dynamic range with a continuous power rating of 150 watts and continuous power rating of 500W for 10 microseconds.

The Duntech Viceroy is manufactured entirely by Duntech Audio at its Australian facility according to strict proprietary quality assurance standards.

It is hand assembled, finished in authentic Australian Jarrah or Black American Oak veneers. The manufacturer's suggested retail price is $4995/pair.

Video & Audio: The Challis Report

ACCUSOUND'S 'PHASE ZERO' LOUDSPEAKERS

After looking at the CSIRO's new A4 digital audio processing technology, this month Louis Challis has been able to turn his critical attention to the world's first commercial loudspeaker system incorporating this technology: the Phase Zero system, developed by Australian firm Accusound Loudspeakers.

Following last month's report on the A4 VLSI Digital Audio Processor, I suspect that many readers will already be wondering both when, or where such equipment will be commercially available. Obviously, the very thought of being able to integrate the A4 'black box' technology into a system is exciting.

A system that can practically and effectively transform a relatively mundane loudspeaker into a good, or better still, an outstanding loudspeaker, is enough to make most mouths water.

Having whetted your appetites, it is now appropriate to further extend that interest by reviewing what is currently the world's first commercial loudspeaker system incorporating the A4 digital transform technology.

Al Henning is one of the Directors of Accusound Loudspeakers at Kirrawee, NSW. I have no doubt that he and his co-directors believed they were enterprising when he recognised the real potential of the A4 VLSI digital audio processor.

As the story goes, on the day when Al discovered that the CSIRO had developed the A4 chip, he immediately hopped into his car, raced over to the CSIRO Division of Radiophysics at Epping, and started negotiatations for a licensing agreement for his company.

Whilst I have no knowledge as to how long he took to negotiate that agreement, what I do know is that Al displayed considerable tenacity, and that he hung in there untill that agreement was forthcoming. At some later date, with a copy of the agreement in one hand and a developmental A4 system in the other, Mr Henning and his co-directors knew that they were standing at the threshold of what they would prove to be a new era in loudspeaker technology.

Whilst the CSIRO has provided Accusound with considerable technical and moral support, there were numerous other issues and obvious potential pitfalls facing a manufacturer which is endeavouring to adopt a new technology. In this particular situation, the CSIRO A4 digital transform technology posed many additional problems, with the design configuration of the speaker enclosure and the selection of the most appropriate drivers being one of those critical issues.

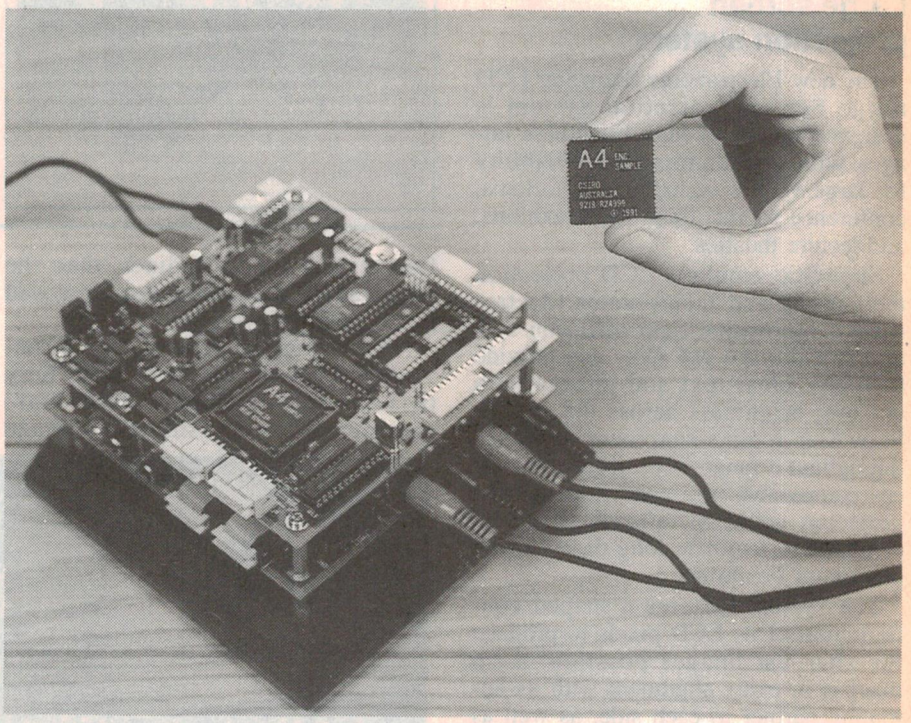
As it happens, Al Henning received unstinting support from Barry Phillips of Magnavox Loudspeakers, who offered to develop new drivers for this particular task.

We understand that it took them almost a year of what they described as a very 'hard slog', to perfect the Phase Zero speaker enclosure. The development time was extended even further, as this was the first production loudspeaker to incorporate the A4 technology.

The loudspeaker design process was further convoluted by numerous technical and visual issues. One of the more prosaic of these was highlighted during Accusound's market research. This indicated the marketplace's preference for loudspeakers with a 'small footprint'. In response to that demand, the designers opted for a tall and thin enclosure face panel. They selected a face width of only 185mm and a height of 1170mm, believing that this would make the frontal appearance of the Phase Zero enclosure 'non-intimidating'.

For our review, we were provided with a pre-production pair of loudspeakers. Each enclosure is solidly constructed from high density MDF board veneered on both sides, with genuine Rosewood veneer on the four sides as well as the top. The enclosure is internally stiffened with solid lateral braces, and when tapped on any of its sides, or on its top, provides a reassuring 'thud' instead of a 'ring'.

With the elongated black cloth-covered protective grille removed, your attention is immediately riveted by the unusual array of five loudspeakers. The driver at the top of the array, in the enclosures that we received, was a 25mm diameter titanium dome



A picture provided by the CSIRO's Division of Radiophysics showing one of their A4 digital audio processor chips, and a development system incorporating it.

This photo shows the Accusound Phase Zero enclosures with their front grilles removed, to show the array of drivers used — and also the porting.

tweeter manufactured in Taiwan. As I will recount below, the production loudspeakers will use a new European tweeter, which will obviate problems previously identified by the CSIRO in the pre-production prototypes.

Immediately below the tweeter are four identical 125mm diameter Magnavox bass-midrange drivers. Whilst I initially thought that the upper pair of drivers were the mid-range and the lower pair were the woofers, that presumption proved to be eroneous. Whilst the manufacturer's literature claims that the four drivers are configured as a tapered array that differentially feeds the higher frequency components to the highest drivers, my investigations led me to a different conclusion.

In principle, the tapered array concept sounds delightful. In practice, there are numerous 'real world' problems to be resolved, not the least of which in this case is how well the tapered array will integrate with the A4 digital technology. There was only one way to resolve that issue. I examined the crossover in order to determine how many components it actually contains, and whether in fact those components fulfil all the relevant requirements of a tapered array.

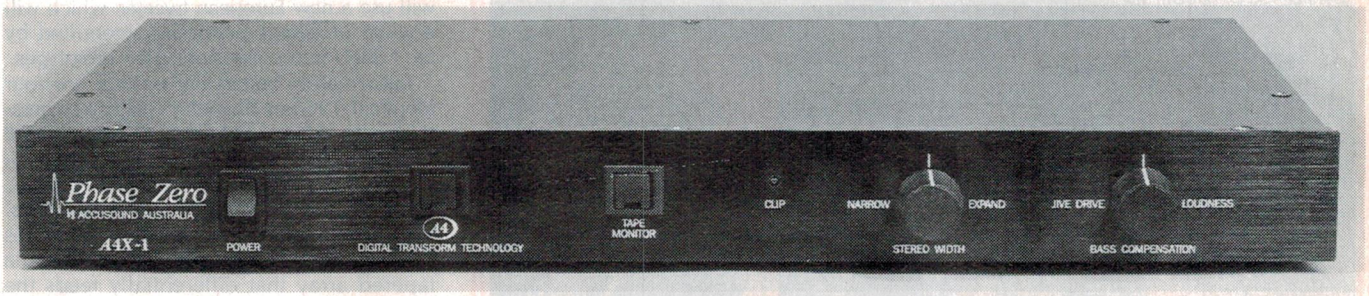
I opened up the enclosure by removing one of the central drivers, which has the crossover immediately behind it on the rear face of the enclosure. The crossover has two large air coiled inductors, three resistors, and four capacitors. That configuration cannot really provide a true tapered array, as was suggested by the manufacturer's literature.

At the rear of the cabinet there are two sets of gold-plated 'universal' terminals, which are incorporated in a neatly recessed plastic enclosure. These terminals have been designed to facilitate bi-amping of the Phase Zero system. In practice, with the A4 digital electronic unit incorporated as an integral part of the system, there are some good reasons for retaining the inter-links between the upper and lower sets of terminals, and retaining a conventional stereo two-channel amplifier, rather than opting for a pair of stereo amplifiers.

The enclosure incorporates a modest amount of bonded polyester absorptive lining, and a single port near the lower edge of the covered front panel area — with relatively sharp edges, which will increase the tendency to 'pant' at high drive levels.

The base of the enclosure is splayed to improve its stability, and on its underside incorporates four captive nuts at each of the four corners. Each cabinet is provided with a supplementary package of four sharp metal spikes. These can be screwed into those captive nuts, so that where required, the enclosure can be 'spiked' to your polished floor. As I discovered some years ago, my emotional support person frowns on such questionable habits, so I left the spikes in their packet...

With each pair of Phase Zero speakers, the manufacturer provides a matching black



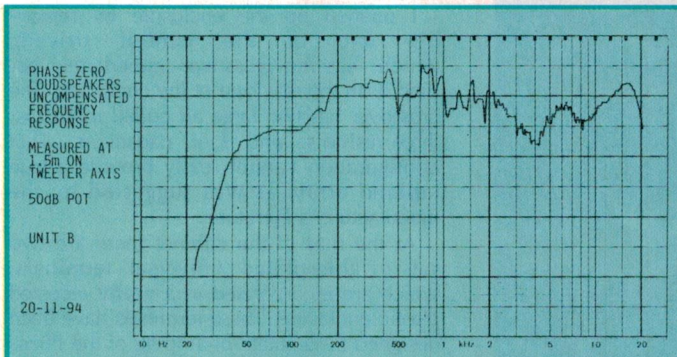
The front panel of the Accusound A4X-1 digital processor unit, or 'black box', which supplies the high tech digital equalisation used to flatten and linearise the performance of the speakers.

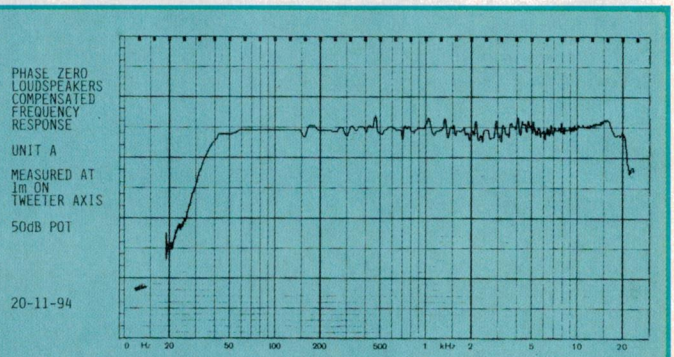
box which incorporates the essential electronics for the A4X-1 digital transform technology. The box is relatively innocuous in its appearance.

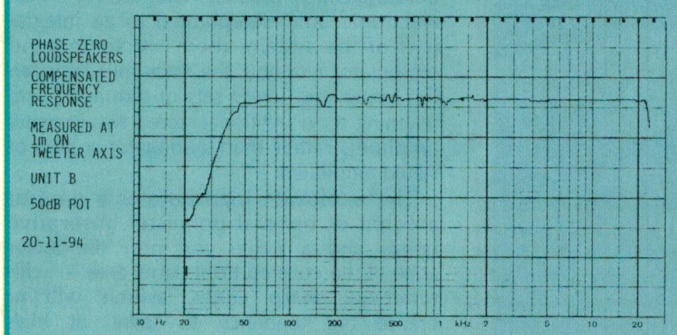
On the front panel there are a series of controls, only two of which really require frequent use, and those are both on the left hand side of the panel. The first is the POWER switch, while the second is the self-illuminating DIGITAL TRANSFORM TECHNOLOGY switch. With the second switch 'OFF', the A4X-1 box provides a flat frequency response. With the switch 'ON', the digital compensation is activated, and the frequency and phase compensation individually determined for your pre-set loudspeakers is then brought into play.

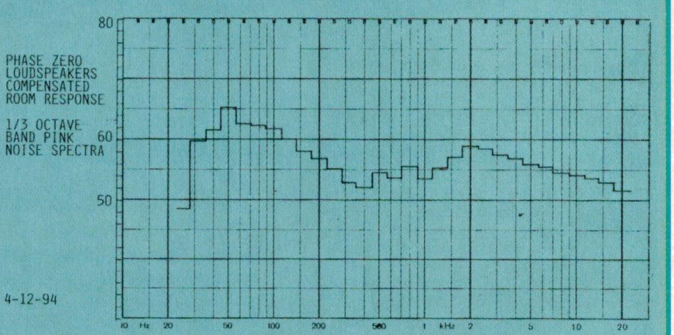
The A4X-1 electronics may be connected by either the normal line 'OUTPUT/INPUT' sockets where they exist, between the pre- amplifier output and the line amplifier input of your main amplifier. Alternatively, if such connections are not available, the unit is connected by means of the TAPE MONITOR sockets and switched by means of the 'TAPE MONITOR' switch on the front panel of the unit.

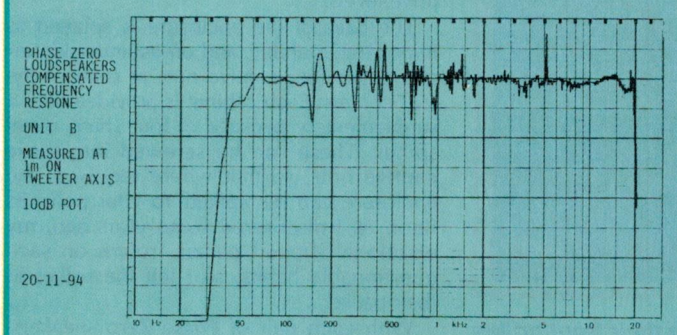
In the centre of the panel, a small recessed LED is provided to indicate the onset of clipping. In practice this LED should never illuminate if the rear gain control has been correctly set. But if that control has not been correctly set, then the electronics will







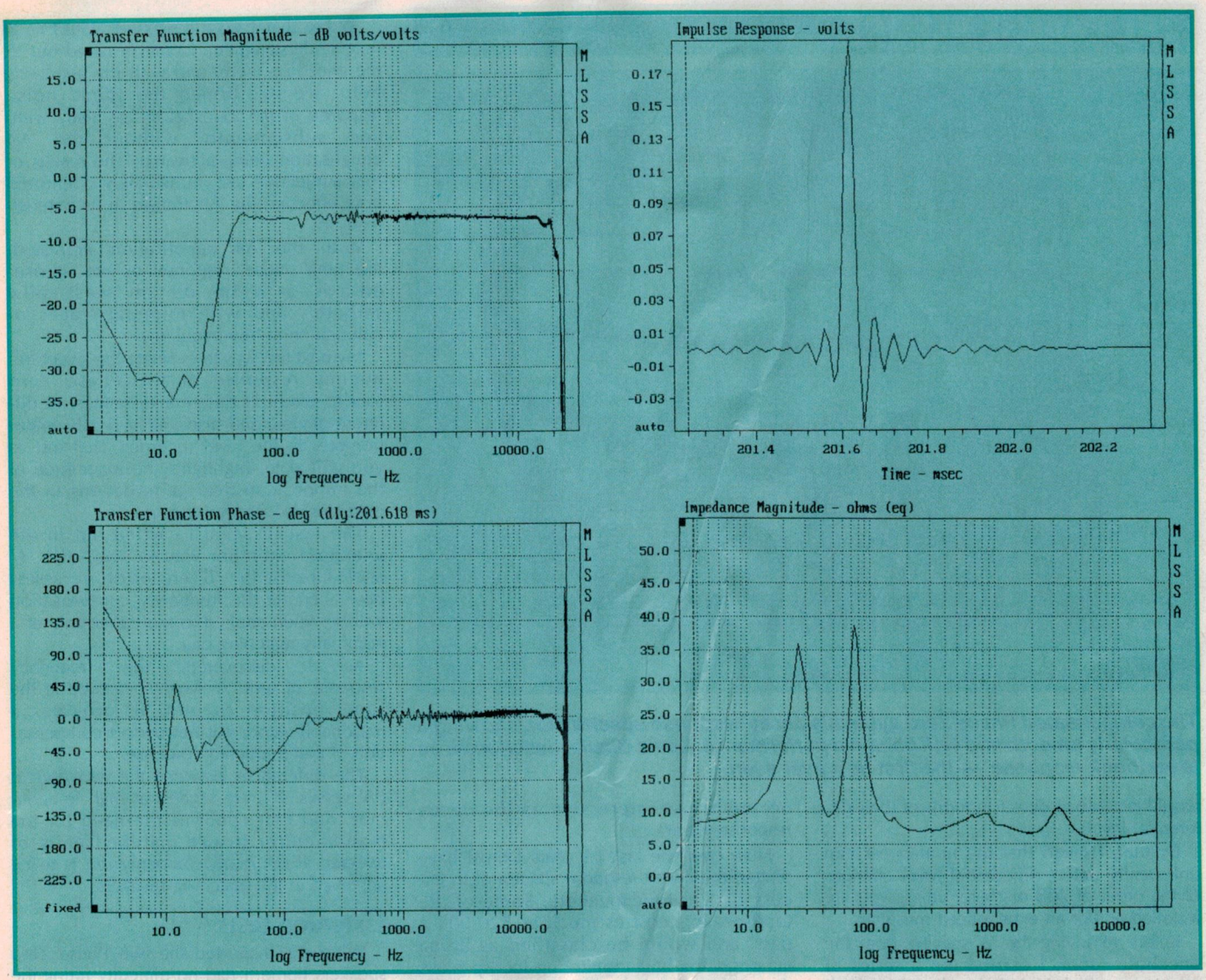




At upper left is the measured response of the Phase Zero 'B' enclosure without digital compensation, while immediately below it is the compensated response as measured on the tweeter axis.

At lower left is the same compensated response measured using a 10dB pot, to magnify the remaining small deviations. At upper right is the compensated response of the 'A' enclosure, for comparison, again using the original 50dB pot.

Finally just above is the compensated room response measured in a typical listening room, taken using pink noise and 1/3 octave band filtering.



At upper left is the transfer function magnitude plot for a compensated Phase Zero enclosure, while at lower left is the matching transfer function phase plot. At upper right is the impulse response, while lower right shows the enclosures input impedance plot. These curves were all measured using MLSSA.

go into the clipping mode on the highest transient signals — or alternatively, the full 100dB-plus dynamic range of the A4X-1 digital technology will not be achieved.

On the right hand side of the A4X-1 module, there are two rotary controls. The closest of these is the STEREO WIDTH knob. This allows you to expand (or contract) the 'spread' of the stereo signal, which may prove to be an advantage in some situations — particularly if you happen to be an inveterate knob twiddler.

At the extreme right hand end of the panel is a BASS COMPENSATION control. This allows you to select a conventional loudness contour with the control turned towards the clockwise extreme, or alternatively allows you to select an artificially boosted response (described as the 'JIVE DRIVE' position), by turning it in the counter-clockwise direction.

The rear panel is relatively simple, with two pairs of Line input/output coaxial sockets, and two pairs of Tape input/output sockets. A single rotary input level gain control is provided on the right side of the rear panel. The power is provided through a conventional IEC mains socket, at the extreme right hand end of this panel.

The plan, or 'footprint' dimensions of the cabinet have been selected so that it can comfortably sit immediately below the majority of power amplifiers, with a power rating in the range 20 - 200 watts per channel. The cabinet is solidly fabricated, so that the weight of such equipment should not result in significant distortion, or in premature damage as a result of 50kg deadweight being applied on a continuous basis.

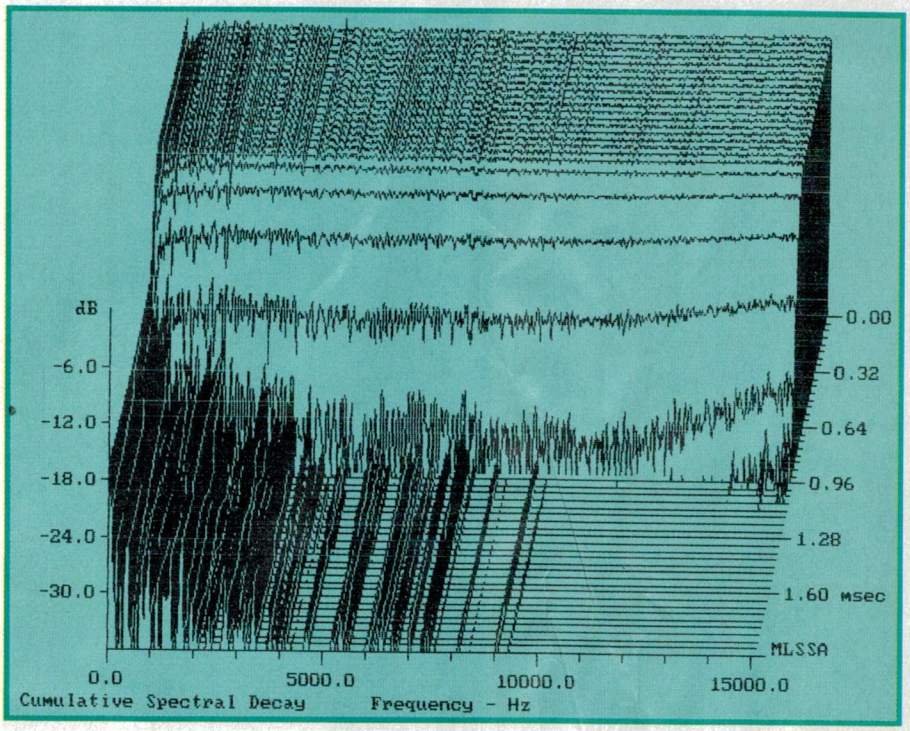
Objective testing

Following their receipt, I placed the 'B' module of the pair of Phase Zero speaker enclosures into my anechoic chamber. Obviously, I was keen to discover what the frequency response would look like *without* the application of the much-vaunted A4 technology.

I was not really surprised to find that the frequency response was not flat. But on the basis of other loudspeakers that I have recently assessed, it is doubtful whether I would have guessed that the frequency response would be nominally +5/-8dB over the frequency range 45Hz to 20kHz. When I measured the swept frequency response of the 'B' module, with the A4 technology activated, the response was flatter than I would have expected, and was effectively +/-1.5dB from 40Hz to 20kHz as you will observe, with a 50dB potentiometer (50dB pot) installed in the level recorder.

With a 10dB potentiometer, the magnitude of the perturbations are more clearly evident — but in a practical sense, they confirm an overall smoother response than might otherwise have been anticipated on the basis of the technology used.

Yes, whilst I acknowledge that there are obvious perturbations, of course all things being equal, the magnitude of those perturbations are generally below the dynamic range of what most human ears



The compensated Phase Zero system's decay response spectra plot, showing a particularly smooth and well behaved performance. Louis Challis described it as 'a textbook response' — the first he's ever seen.

would be able to detect in terms of their differential level.

By that, I mean that the human ear can only really detect differential level changes of the order of 2dB or more, unless you are a skilled and/or an experienced musician.

Before removing the 'B' speaker from the anechoic room, I carried out a series of other tests which included a phase test (both with and without the A4 frequency compensation applied), an impulse response, a transfer function, an impedance curve, and most telling of all, a decay response spectra test. The phase response of the equalised Phase Zero was particularly impressive, but not nearly as impressive as the decay response spectra.

Now over the last 13 years I must have plotted the decay response spectra of in excess of 100 loudspeakers. Some of the loudspeakers cost as much as $20,000 a pair, and would be classified as being 'amongst the best monitoring loudspeakers that money can buy'. But the Phase Zero's decay response spectra was the first that I would describe as being a 'textbook response', with no significant signs of frequency, non-uniformity and virtually negligible signs of low level ringing in its decay response spectra.

Measured performance of Phase Zero Loudspeakers
Serial Nos 1501 and 1502

Frequency Response	40Hz to 20kHz	+/-2dB	
Crossover Frequencies	3.5kHz crossover to tweeter		
Sensitivity (for 89dB average at 1m)	2.83 VRMS = 1 Watt (nominal into eight ohms)		
Harmonic Distortion @ 1m	**96dB 100Hz**	**96dB 1kHz**	**90dB 6.3kHz**
2nd	32.7	22.8	39.43
3rd	38.6	35.7	62.5
4th	55.7	41.5	-
5th	57.9	56.3	-
THD	2.6%	7.5%	1.8%
Input Impedance	63Hz	18 ohms	
	250Hz	7 ohms	
	1kHz	8 ohms	
	4kHz	8 ohms	
	8kHz	6 ohms	
	Minimum at 6.3kHz	5.5 ohms	

To say that I was impressed would be a mild understatement. I quickly raced out to the anechoic room, and with my assistant's help, we auditioned the 'pink' noise response of the loudspeaker — firstly with, and subsequently without the A4 equalisation being activated. The results of that subjective test immediately confirmed how effective the A4 transform technology really is.

With the A4 equalisation activated, the 'pink' noise response of the speaker on axis at 1.5m or 2m was 'silky smooth', and with minimal traces of colouration at low frequency.

My next test was to evaluate the swept frequency response of the Phase Zero loudspeakers at different distances, at different angles, and also with a 10dB potentiometer in the level recorder. That test as you will note, highlights the magnitude of the minor acoustical perturbations in the compensated frequency response.

The last test that I carried out in the anechoic chamber was to swap the 'A' enclosure for the 'B' enclosure, to assess how accurate the frequency compensation will be when applied to the 'other unit' of a nominally matching pair.

As I discovered, the frequency response of unit 'A' when measured at the same position as unit 'B' provides a reasonably good, but not perfect compensation of that frequency response.

The differences between the two spectra ('A' versus 'B'), are highest at high frequencies, and that confirms the need for the manufacturer to use matched pairs of tweeters if optimum compensation is to be achieved in the matching speakers.

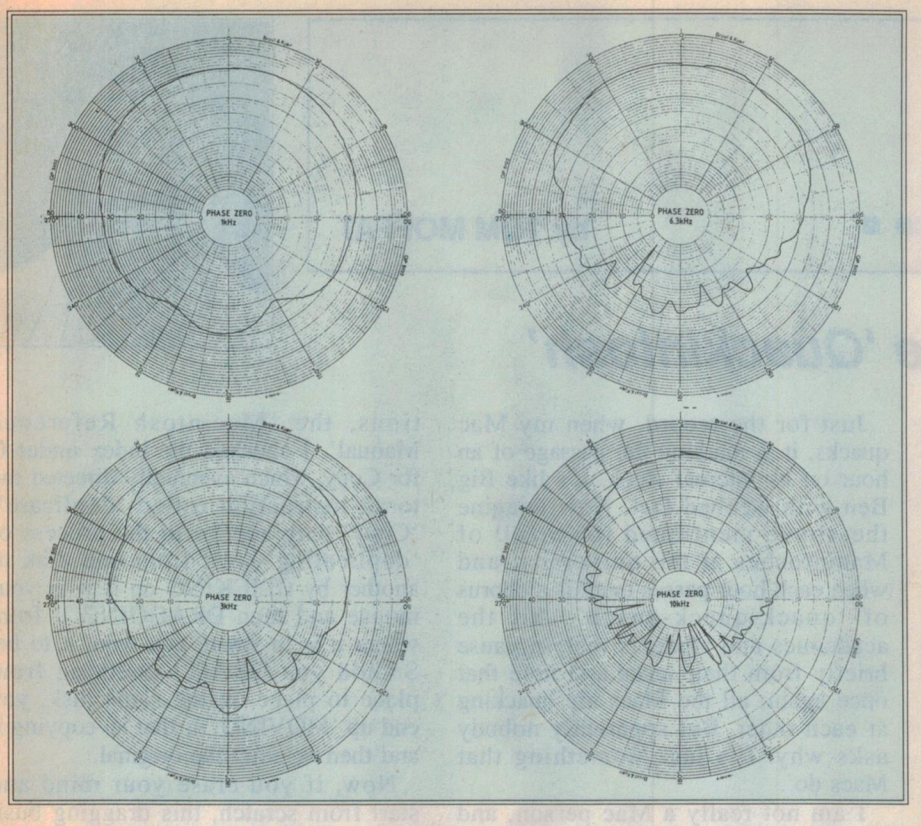
Listening tests

When I transported the two Phase Zero speakers home, I had no difficulty fitting the two cartons on the back seat of my car, and I soon had them installed in my living room. There was absolutely no problem to couple the outputs of my pre-amplifier stage to the inputs of the A4X-1 digital transform 'back box' unit, and similarly its outputs to the inputs of my separate power amplifier.

With the very willing support of my listening panel, we proceeded with an evaluation of the subjective performance of the compensated Phase Zero speakers in a direct 'A-B' comparison with my B&W 801M monitor speakers.

The first disc we selected for our evaluation was track 18 of the Sheffield Coustic test disc, which provides three minutes of 'pink' noise. The subjective impressions of the anechoic room were replicated in my listening room, and apart from the low frequency end which sounded quite different to what I had heard in my anechoic chamber, the rest of the response was still very smooth (see attached graph).

We progressed to assessing the response of the loudspeakers on what I have always found to be the most critical test of all — the human voice. Dame Joan Sutherland provided her staple test, and was supported



The measured polar response characteristics of a compensated Phase Zero enclosure, at 1kHz, 3kHz, 6.3kHz and 10kHz. Again, they're commendably smooth.

by Bolshoi star Zurab Sotkilava in a brand new disc in which he sings 'Famous Russian Tenor Arias & Folksongs' (Sony Classical SMK 57653).

At high listening levels (peaks of 95-105dB), I was aware of a significant change in tonality and spectral balance between the Phase Zeroes and my monitor speakers. Flat frequency response is one parameter, distortion and particularly high frequency distortion is — it would appear — a somewhat different matter.

Whilst performing well at low to modest listening levels, the Phase Zero loudspeakers may not necessarily respond like a perfect loudspeaker at high listening levels. At those levels, the dynamic transfer characteristics of the drivers (and particularly the tweeter) assume a very critical significance, which cannot be understated.

I progressed to a more contemporary disc, with the famous Dave Brubeck playing a new solo recording 'Just You, Just Me' (Telarc Jazz CD-83363). This appears to be Dave Brubeck's first solo recording in nearly 40 years, and in my opinion, it was well worth waiting for.

With this more contemporary style of music I had great difficulty discerning differences between the monitor speakers and the Phase Zeros, and I guess that's the way it should be.

Summary

I kept the Phase Zero loudspeakers at home for nearly two weeks, and listened to a wide range of classical, operatic, orchestral and pop music. Their performance was by and large extremely good, and in many respects, better than could be expected from a speaker system where the manufacturer has already advised that the tweeter will be changed to a pair of individually matched superior drivers when the full production run is released, early in 1995.

The Phase Zero loudspeakers and their A4X-1 technology will possibly be viewed as a gimmick by many readers. Let me immediately dispel that view from the outset. The A4 technology is here to stay, and it offers dynamic performance which is a delight to behold, and a delight to audition.

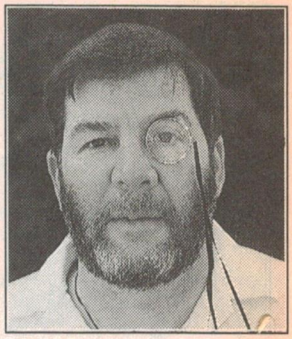
I am sufficiently impressed with the A4 technology to state positively that this development is the most outstanding that I have seen anywhere in the world in the last 10 years. I believe that as the development of the A4 technology expands, it will change our perception of what we want from a loudspeaker. More importantly, it appears to offer a practical means of replicating the dynamic characteristics of the original sound field in the home listening environment.

The Phase Zero enclosures measure 1170 x 185 x 300mm (H x W x D), and each weigh 23kg. The quoted price for the Phase Zero system is $4000, including the all-important A4X-1 'Black Box'.

For further information contact Accusound Loudspeakers, 2/7 Marshall Road, Kirrawee 2232; phone (02) 545 3905. ❖

Moffat's Madhouse...

by TOM MOFFAT



Reflections on the 'Quackintosh'

Ah! It's a bright summer morning and the birds are singing. A flight of finches just fluttered past, and the currawongs are out there begging for their daily hit of dog food. For months, every day has been heralded by the family of kookaburras that's made its home in one of our trees. They start the morning winding up their screeching apparatus, first with low giggles and then progressing to maniacal shrieks. Lately they've even been giving their babies screeching lessons at 5:30am.

Birds are no novelty to us; we even had some peacocks for a while. So it came as no real surprise when I was working away with a Macintosh computer one day, and something went 'quack'. It was obviously just one of the ducks. But hey, wait a minute — we don't have any ducks! What went 'quack' then? Must have been my imagination.

Some time later — 'quack' again. Just one quack, that's all. And when it happened a third time I finally deduced that the quacks were coming from the Macintosh. Again, no big surprise here, because the Macintosh has quite a vocabulary of interesting noises. It sometimes chimes, like an airplane does before it says "This is your captain speaking..." And if it really wants to draw your attention, it emits a raucous 'boingggg....'

But why does the Mac quack? I mentioned this strange behaviour to an acquaintance, who spends a lot of time at the university where there are Macintoshes by the room-full. "Oh, don't worry about that", he said, "all Macs quack". But why do they do it, I asked? "I've no idea," said the uni-person, "it's just something that Macintoshes do."

This illustrates a principle I shall call 'having blind, unquestioning faith in one's computer'. If the computer does something it must have its reasons. Inquiring into the computer's actions is tantamount to asking if life really has meaning.

Just for the record, when my Mac quacks, it is marking the passage of an hour on its internal clock. It's like Big Ben with webbed feet. Now imagine the above-mentioned room full of Macintoshes at the university, and when each hour passes there is a chorus of 'quack-quack-quack'. All the academics and students therein pause briefly from their tasks and note that once again, all the Macs are quacking at each other. But apparently nobody asks why. It's just 'something that Macs do'.

I am not really a Mac person, and I'm somewhat ambivalent about working with a Macintosh. After having the thing around for several months I'm still running with my L-plates, and it seems that the Mac resists my every attempt to get it to do anything. It definitely has a mind of its own, if computers have minds.

But one spinoff from its 'user-friendliness' is its rather wry sense of humour, which I find quite delightful. The quack is just great; it's almost as if the computer is taking the Mickey out of itself. Same goes for the boings.

I suppose if you really worked at it, you could re-program the thing so it only used its boring old this-is-the-captain-speaking chime for all announcements, making it more suitable for a stodgy business environment. Or you could go the other way — I understand there is one Macintosh in the university library that greets every action with an announcement from its speech synthesiser: "I MAY BE A COMPUTER BUT I'M NOT STUPID!"

Well, I'm a person and I don't think I'm stupid either, but sometimes I feel the Macintosh *does* think I'm stupid. What bugs me is that the Mac has its own ways of doing things which are totally beyond my control. For instance, I wanted to copy a file. Since the Mac has no command line, I couldn't just type 'copy...' as you do with MS-DOS.

So I decided to consult the instructions, the 'Macintosh Reference Manual'. I checked the index under C for Copy, which eventually directed me to an instruction called 'duplicate'. 'Copy' only applies to the process of 'duplicating' stuff from one disk to another by CLICKING on it with your mouse and then DRAGGING it from where it is to where you want it to be. Should you DRAG something from place to place on the same disk, you end up 'MOVING' it; that is, copying it and then deleting the original.

Now, if you erase your mind and start from scratch, this dragging business does seem somewhat logical. And it didn't take stupid old me too long to figure out that if you want to DELETE a file, you DRAG it to the little image of a garbage can. So it seems to me that to be a happy Mac user, it is best to start with a blank mind as far as computers go.

A similar situation existed at the place where I did pilot training, a very large commercial flight school with branches for both fixed-wing aircraft and helicopters. The chief helicopter instructor told me that his most difficult students were the ones who were already fixed-wing pilots, because you had to un-teach them all their old flying habits before they could begin to handle a helicopter. The problem appears similar with MS-DOS and (horrors!) CP/M hackers like me: we've got to un-learn all the old habits before we can successfully take on the new.

Not long after I got the Listening Post II and Wesat kits going, I started hearing requests along the lines of 'when are you going to do versions for the Amiga?'. So I bit the bullet, bought an Amiga computer, bought a pile of expensive books, and got into it. And the first thing I discovered was that I was presented with the dreaded Graphic User Interface when I turned it on.

The second thing I discovered was that the Amiga designers had made allowances for troglodytes like me. It was possible, with minimum effort, to

arrange the Amiga to work from a traditional command-line interface instead of the new-fangled GUI. Once I figured out how to do that, it was goodbye GUI forever, at least on the Amiga. Saved from the grip of progress that time!

But as for the Macintosh, well — it doesn't look like there is *any* way to revert to a command-line option. So I was just going to have to get with the GUI.

As this is being written (on my trusty MSDOS-based laptop), I've had about two weeks of intensive Mac experience. I've been busy working up a new version of the Pocket Packet radio modem system, so that it -

(1) runs on the Macintosh, and

(2) works in the latest TCP/IP mode.

Because of the Mysteries of the Mac, I thought it prudent to get similar TCP/IP software running on the IBM-PC and then transfer the techniques learned over to the Mac. So now we've got a TCP/IP version of Pocket Packet working on the PC as well.

Most of the work involved editing various configuration files to make the software and the Pocket Packet modem talk to each other. And at one stage I had PC laptop and a Macintosh Classic II sitting right next to each other on the table, each editing its own version of the configuration file in its own individual way. So it was an ideal opportunity for an A-B comparison between the two systems.

An example: let's move a couple of lines of text from one place in the file to another. On the PC (at least my laptop, running the VDE text editor), you use the cursor keys to place the cursor at the start of the block you want to move, and then press the F7 key. Then you move to the end of the block and press F8. The block changes colour, so you can confirm it's what you want to move. Then you move the cursor to where you want the block to be, and press F9. The block is moved; all done.

To do the same thing on the Mac, you use the mouse to move the cursor to the start of the block. Then you hold down the mouse button, and sort of wipe the cursor over the text you want until the correct block has changed colour, when you can release the mouse button.

Now you must open a menu at the top of the screen, and click on 'cut'. The screen jumps down to where the block was, and you notice the block's not there any more. Next you use the mouse to move the cursor to where you want the block to be. Now you open the menu again and click on 'paste'. The block is moved to the new position; all done.

I have gone through these motions many, many times, first on one computer and then on the other — left computer, right computer, left computer, right computer. I think I've given both of them a pretty fair trial. But I am sorry to announce that I still find the PC way of doing the job quicker, easier, and more foolproof. Note that we're talking MS-DOS here, not Windows, which works pretty much the same as the Mac.

Still, it is patently obvious that I am going to have to learn to love the GUI way of doing things eventually. Present IBM-PC's, like the Amiga, always give you the option of abandoning the whole GUI thing and going back to work in DOS. But two new developments — the new version of Windows known as 'Chicago', and an interesting operating system called OS-2 — do away completely with the need for MS-DOS in the computer. And with goodbye DOS, it's goodbye command-line and hello GUI forever.

Electric dictionary

Now let's change the subject somewhat. In the first paragraph of this column you'll notice two words — currawong and kookaburra — which I am pretty sure are spelled correctly. This is no mean feat for a writer such as me, of American manufacture, educated in a land where the above-mentioned birdies only exist on travel posters, if at all.

How did I get so smart and talented, you say? With my trusty electric Macquarie Dictionary, that's how! I used to carry a little yellow book around in my 'portable office' case, a mini-Macquarie Dictionary. But now that dictionary lives within my laptop computer on the hard disk.

Some time ago you may remember I came across some other books on these new 'Megafloppy' computer disks; the Australian Constitution, the full text of the High Court's Mabo decision, and the Holy Bible. All are useful reference works on occasion, but the one to get used every day has turned out to be the new Macquarie Dictionary on a Megafloppy, transferred across to my hard drive.

I must admit I didn't have a clue how to spell either of those bird names, but I guessed that one had to start with 'curr...'. The electric dictionary lets you do wild-card searches, using the '*' symbol to match anything. So I told it the word I wanted was 'curr*', and whacko! Along with 'current' and 'currency', there it was: 'currawong'. As for kookaburra, a search for 'kook*' produced, as well as the bird, 'kook' or 'kooky', a strange or eccentric person. Hey, maybe that's how that silly bird got its name!

I've always thought a personal online dictionary would be a handy thing to have, and I've been hanging on for several months waiting for the release of this one. It's particularly useful for me because of its Australian emphasis. The spell-checker I always use when writing this stuff is of American origin, and although I've tried to teach it more civilised spellings from time to time, the occasional clanger still creeps through. And when you hit it with something like kookaburra the thing goes right off its brain, suggesting such charming alternatives as 'knockwurst'.

By now the Megafloppy Macquarie should be available in just about any newsagent in the land, and in keeping with the tradition of that little book I used previously, the disk is bright yellow. If you ever do any writing, even as a student doing school reports, the electronic dictionary is certainly worth a look. ❖

APPLE'S QUICKTAKE DIGITAL CAMERA

This affordable, pocket sized digital camera can be hooked up to a Windows-based PC as well as an Apple Macintosh. With direct electronic output of its captured images, it will probably answer the picture-making needs of many.

by BARRIE SMITH

If you've lived happily with the operational style of a Nikon or Canon SLR, you may have difficulty coming to grips with the Apple QuickTake 100. But, if you've craved for a 'transparent' method of getting a picture of any sort expeditiously into your Mac or PC, then QuickTake is your answer.

Compared to a conventional still camera, QuickTake has some pluses and some minuses. On the plus side, there's no film to load, no wait for processing and — if your images are to end up inside a computer — no scanning. On the minus side the camera has a maximum capacity of only eight shots (at top resolution), no focus or exposure controls, and possesses the most rudimentary flash system. The shutter speed, in low light, could also induce camera shake in less-practised hands.

An attractively styled charcoal-toned case houses the Kodak-designed CCD (charge-coupled device) sensor, optical system and other circuitry. Externally there is a sliding lens cover and flash unit on the front, while at the rear is an LCD panel displaying operational modes such as flash on all the time, auto or flash off, resolution level, self timer and exposed frame count.

At the side is another panel which conceals the serial port and 4.5V DC input. On top is the shutter button — and here, I found trouble within two frames of shooting my first batch of pics. The firing button is just too easy to trigger accidentally, and that's exactly how I captured my first digital 'walking feet' image...

The camera is powered by three AA batteries (NiCad or conventional accepted). The images are stored on an internal Flash EPROM, and will remain in memory for a year even if batteries are removed; should the lens cover (which doubles as the power switch) be left open, the camera will shut down after five minutes.

The picture format is 4:3 ratio. You can expose up to 32 pics at the 'standard' resolution of 320 x 240 pixels, or eight at the 640 x 480 pixels high resolution. Both are in 24-bit colour, and resolution levels can be mixed.

Apple's QuickTake 100 Basic Information

1MB Flash EPROM stores up to 32 standard-res or eight high-res image files or mix of both. Storage time up to one year.
Shutter speeds 1/30 to 1/175 sec. Aperture f/2.8 to f/16.
Weight: 500g.
Film equivalent: ISO85.
Interface: Mac 68020 equipped computers, 4MB RAM + 8MB of virtual memory or 8MB RAM, HD floppy drive, System 7.0.1 or later, hard drive with 10MB or more.
Windows PC compatibility.
Accessories: Travel case, battery booster pack.
***Pluses**: Simple computer interface.*
***Minuses**: Very basic auto exposure system.*
RRP: Camera $995. PhotoFlash $245, bundled with Camera.

Once dumped into a Mac or PC, the file sizes come in at around 30KB or 120KB respectively. So a whole run of 32 standard-res or eight hi-res pics will total just under 1MB.

Because the lens is fixed focus, you are restricted to a minimum shooting distance of 1.9 metres (4ft). This I didn't find a great worry, as the 8mm focal length lens is equivalent to a 50mm on a 35mm SLR and pleasing head and shoulder shots are still possible.

If you're a fiddler, I dare say you could try slapping a supplementary lens on the front and move in closer. The viewfinder is a simple, direct optical design, but more than adequate for this style of camera.

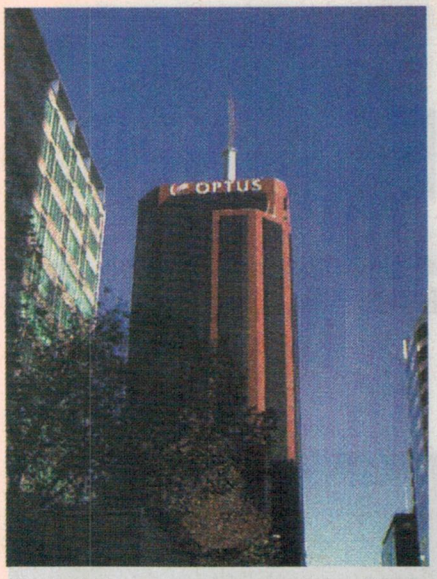
Matching software

The interface software is supplied on two HD floppies: this includes the QuickTake application, camera system extensions, Color Sync control panel and a range of profiles for a number of colour monitors.

The application loads the camera images onto your hard drive, a chore which takes little more than a minute. Once you've established a group of thumbnails on the desktop, you can select an individual image, rotate in 90° increments, cut, copy, paste, crop, rescale and zoom in on it. Export file formats include TIFF, BMP and PCS (Windows), JPEG and native QuickTake. Additionally, the images can be transformed to single- bit, 8-bit and 16-bit renditions. Should you save a high-res file in uncompressed PICT format, the final file size will be close to 900KB.

In practice

I found it fascinating to hook up the camera to a Mac and control it from the desktop. Like to take a shot? All func-



One of the pictures taken by Barrie Smith using the Apple QuickTake 100.

tions can be controlled through the QuickTake application; fire the shutter and the image comes up on screen in around 10 seconds.

What's the quality like? Opening a high-res file on my 14" Trinitron screen's 72dpi display gave me a picture a touch unsharp; mind you, that's a display of around 280 x 210mm.

The standard-res file quality was, I have to confess, a little ragged — so my tip is to go for high-res every time. When I output the pics to a 360dpi inkjet colour printer the image size shrinks to 110 x 85mm and apparent sharpness rose at the same time, resulting in a truly useful picture (see example).

The exposure system is elementary in the extreme and too easily fooled by bright skies — and any overall lighting arriving on the subject from any direction other than 'over the right shoulder'. I achieved superb results in soft lit conditions.

Apple recommends that the flash system should only be relied upon for subjects within a 1.9 - 4.5m (4-9ft) range. To this I would add that you should look for interiors with light ceilings and walls to augment this.

Colour quality I found to be surprisingly good — well saturated, and provided your exposure was within ball park, a little judicial fiddling with a package like *PhotoShop* or *PhotoFlash* could reward you with excellent results. The camera is available as a bundle with *PhotoFlash* software, and this is an option I recommend.

I suspect Apple's QuickTake digital camera has a lot of customers out there waiting for it. ❖

THE WORLD'S BIGGEST TELESCOPE

Around the turn of the century, the twin 10m telescopes of Hawaii's Keck Observatory will no longer be the world's largest optical telescope. That status will pass to the ESO's Very Large Telescope, a set of four 8.2m instruments planned for a mountaintop in Chile.

by GEOFF McNAMARA

It's a well-known fact that the bigger the telescope, the more you can see. But astronomers reached a crisis point a few years ago, when they found that there was a limit to how big you could make a telescope and still get it to point at the sky without falling over (or at least, distorting its framework).

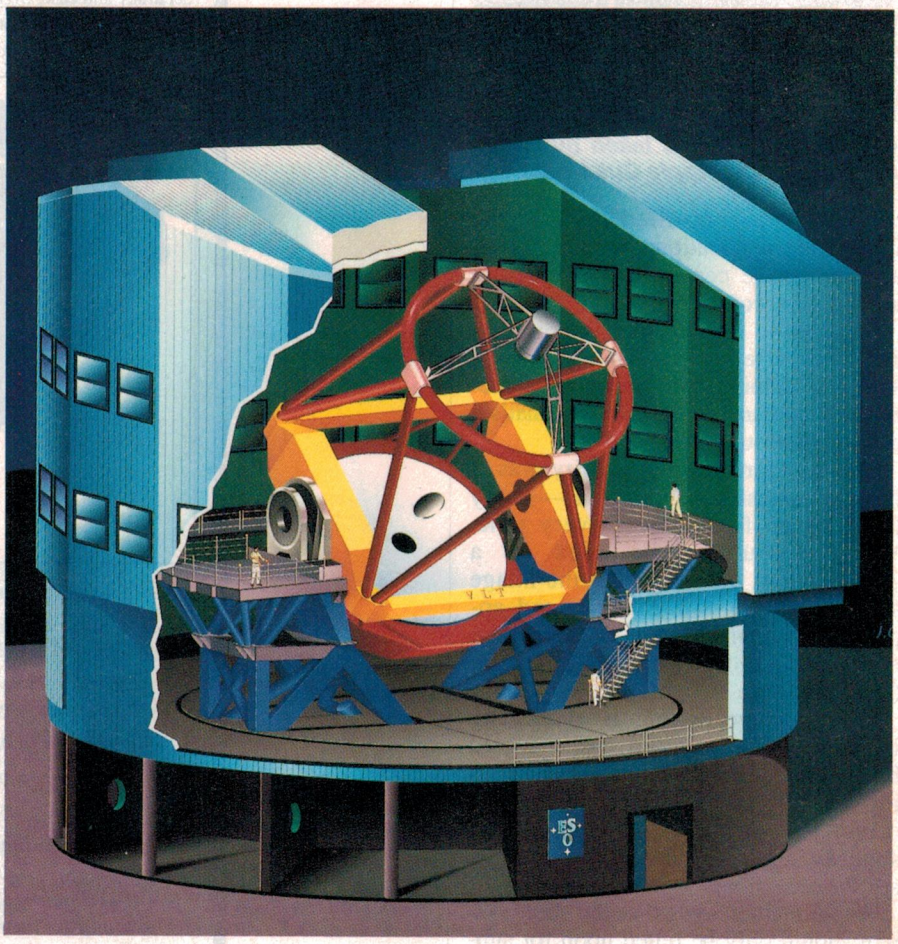
The telescopes with the largest single mirrors ever made will be a pair of giant 10-metre telescopes under construction at the top of an extinct volcano in Hawaii. But the record for biggest telescope will be overturned almost as soon as its made. By the turn of the century, the largest telescope in the world will have an equivalent aperture of 16 metres. The telescope is imaginatively called the 'Very Large Telescope' (VLT).

The VLT is actually four 8.2-metre telescopes. By combining the images produced by all four telescopes, the VLT will perform as if it were a much larger telescope — but without the structural problems associated with such a large telescope. The quartet is being built by the European Southern Observatory (ESO), a consortium of astronomers from eight European countries.

The VLT is being built on top of Cerro Paranal, a 2640-metre high mountain in the middle of a desert in Chile. The skies there are among the darkest, steadiest and driest (important for infrared astronomy) in the world. The ESO is now ready to install the first telescope's enclosure.

Radio astronomers have been able to combine the signals of widely-spaced receivers for many years, and this is in fact the basis of the well-known Australia Telescope whose individual components are separated by up to hundreds of kilometres.

Like the Australia Telescope, each of the four telescopes that make up the VLT can be operated independently or in unison. When working together, their combined light-gathering power will be the equivalent of a 16-metre telescope.



When used as an interferometer, the telescopes will have the resolving power of a telescope with an aperture the same as the distance between the two farthest telescopes — about 100 metres. Alternatively, the telescopes can be used on the same object but with different instruments, or on four different objects.

The appearance of the completed observatory will be a far cry from the traditional dome-shaped buildings that were used to house telescopes in the past. Designers have since discovered that the dome is one of the worst shaped-buildings that you can use for a telescope, simply because the air currents it creates around the telescope distorts the images. The new method is to use box-shaped enclosures that move with the telescope as it looks around the sky. To further improve the steadiness of the surrounding air, astronomers will work in laboratories and move between the telescopes underground. Nothing will protrude above ground except the giant telescopes themselves.

Telescope One of the VLT is due for completion around late 1997. The remaining telescopes will be completed over the following few years. The total cost of the project is estimated at $430 million. ❖

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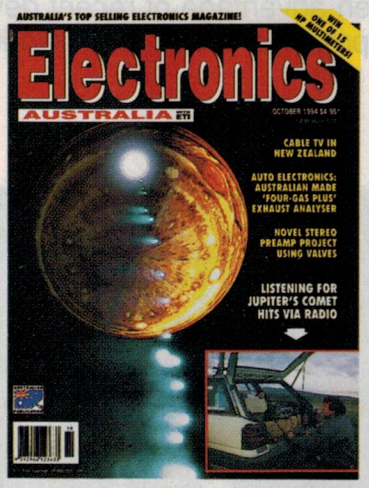

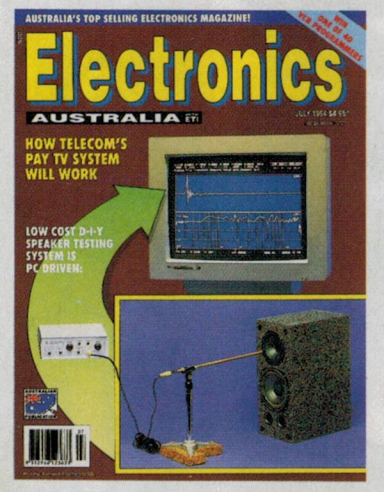

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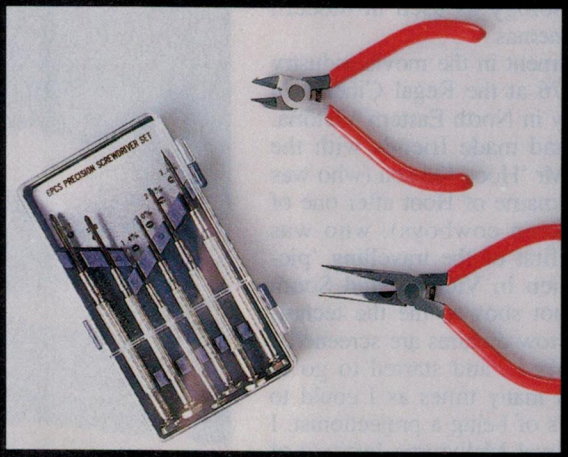

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HIGH TECH IN A MODERN CINEMA

Electronics has always had strong links with the motion picture industry, and from time to time in the past we have published articles describing the development of cinema technology. Here's an update, showing the way modern 'multiplex' movie theatres have taken advantage of recent developments in electronics and computers. The author is an experienced projectionist, currently working in Shepparton, Victoria.

by REG LEAHY

Over the years that I have been reading *Electronics Australia*, I have enjoyed the many articles on the movie industry. Following the article by Mr Rod Maclean, in the March 1993 issue, I decided to put finger to keyboard and take readers from the era when I myself started to get involved in projecting moving images onto a screen, up to today's technology as used in modern 'multiplex' cinemas.

My involvement in the movie industry started in 1976 at the Regal Cinema in Benalla, a city in North Eastern Victoria. Here I met and made friends with the proprietor, a Mr 'Hoot' Gibson (who was given the nickname of Hoot after one of the silent screen cowboys), who was amongst the first of the travelling 'picture show' men in Victoria and South Australia. Hoot showed me the techniques used in how pictures are screened.

I was 'hooked', and started to go to the theatre as many times as I could to learn the skills of being a projectionist. I enrolled at Royal Melbourne Institute of Technology and completed a two year correspondence course. In 1980 I passed the Victorian Public Health examination and obtained my Cinematograph Operators Licence. During my practical training at the Regal Cinema, I performed the duties of assistant projectionist — cleaning the projectors, threading the film in the projectors, cleaning the mirrors, replacing and adjusting the carbons in the lamphouses, and rewinding the film as each spool finished screening. By the time I had completed these tasks, the next spool 'changeover' was ready, and the whole cycle started again.

After a few months of practice, I was achieving having everything ready for the next changeover in a shorter time than before. This allowed me time to relax and enjoy some of the film that was screening.

Our lead picture gives a view of the film path from platter to projector, with the Manager making adjustments to the feed out rollers.

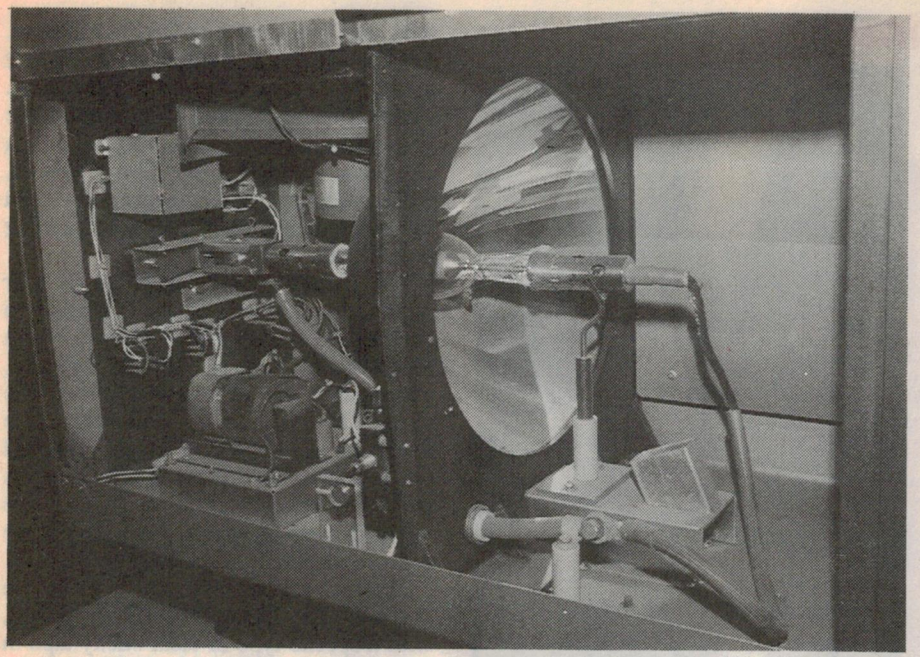


Fig.1: A 4kW Xenon bulb, in the centre of the parabolic mirror with the igniter circuitry at the back, as used at the Twilight Drive-In Theatre, Shepparton, Vic.

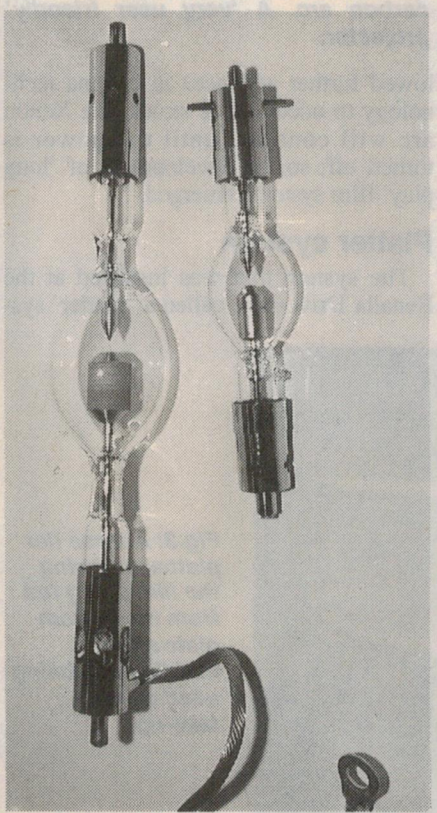
On one occasion Hoot said he had to go downstairs to the ticket office and that he would be back in a moment. The film in the running projector started to reach the end of the spool and a changeover was rapidly approaching, with no Hoot Gibson to be seen. I took the bit between my teeth and managed my first solo changeover. It was spot on. Afterwards Hoot came back into the projection room and said that he had been sitting in the theatre, waiting to see how I would manage a changeover without supervision...

As I was preparing my notes for this article, a pamphlet arrived on my desk where I am presently employed, advertising a new digital sound system for theatres. When I had finished reading the article, I felt like Marty McFly and Doc Brown and had gone *Back To The Future*.

(At this point I would suggest that if you haven't already read the article by Rod Maclean in the March 1993 article, you might read it. He describes one of the first sound systems developed for commercial use. Basically it consisted of a turntable driven by the projector motor, with a 16" (40cm) disc revolving at 33.3rpm. The projectionist would cue up the record to synchronise with the start of the film, prior to the commencement of that spool.)

The new digital system uses a time code placed between the existing stereo soundtrack and the image area. As the film moves through the projector, the timecode is read by a special optical reader, placed near the existing soundhead, where it is then decoded to control the CD-ROM disc in a modified CD player. The discs are synchronised to each individual frame of the film, by the time code.

For a theatre that has only stereo playback, a single disc is used and contains four hours of soundtrack. A theatre with a full sound system (left, centre, right, left and right back channels, and a subwoofer) requires a two disc player which gives three hours and 20 minutes of playing time.



A view of two Xenons out of their protective covers, showing a 4000W bulb and a 1500W bulb.

If the wrong discs are sent with the film, the time code signal will not let the disc play and will default to the original optical soundtrack. By using this method with the timecode and conventional stereo soundtrack on the one film, the film distributors do not need two different prints of the same film — i.e., one with a digital soundtrack and the other with an optical soundtrack.

This, as you can see, is a different approach to the system as developed by Kodak, where the digital information is placed on the film, replacing the existing soundtrack. (See *Electronics Australia* November 1990, page 20.)

Now back to the past, to the Regal Cinema where I started my interest in being a projectionist. Its plant consisted of two Kalee projectors with Gaumont arc lamphouses, a valve mono amplifier, manual resistance dimmers for the lighting and an AC Transarc stereo slide projector. This was standard fare for the theatres of this vintage.

The owner of the Regal was very progressive in his thinking and decided he was going to upgrade his theatre by the installation of a Dolby Stereo Surround Sound decoder and a four channel amplifier (see *Electronics Australia* April 1990 page 34). He also decided to install solid state light dimmers and to replace the old carbon arcs with Xenons.

Xenon arcs

The Xenon short arc was developed by the Zeiss Icon company of Germany in 1954 (Fig.1). The name Xenon is derived from the Greek word 'Xenos', which means *stranger*, and is a reference to the rarity of the gas — in which only one cubic metre is found to every fifteen million cubic metres of air.

The Xenon arc is a gaseous discharge lamp, with high quality tungsten electrodes set in a fixed gap relationship between anode and cathode, and is sealed in a blown quartz bulb in an atmosphere of pressurised Xenon gas. The initiation of the arc between the fixed electrodes is achieved by a pulse of high voltage radio frequency power which jumps the gap and ionises the gas, thereby providing a path for the main DC supply to maintain the arc. Once established, the arc is stable after a very short warm up time.

The colour characteristic of the Xenon lamp is as close to daylight as can be

achieved. The bulbs are rated from 450 watts to 6500 watts and are guaranteed for a minimum of 1000 hours. At the theatre where I am currently employed, there is one Xenon bulb that has achieved over 6000 hours and still going strong.

At the Regal Cinema the existing carbon arcs were replaced by Xenons and the photoelectric cell was replaced with twin silicon solar cells on a modified bracket to allow adjustments to be made — so that the stereo cells reads each track correctly, without any crosstalk. The Dolby decoder, four channel amps and speakers were finally connected and tested. This produced a dramatic improvement to the shows, for the enjoyment of the cinema patrons. All this was attached to a pair of Kalee projectors which were second hand when the theatre was built in 1956!

At the same time that the Regal Cinema was being updated, the ownership of the local drive-in theatre had changed, and the new owners also replaced the old carbon arcs with Xenons, replaced one of the old Cumming & Wilson projectors with a new Simplex projector (Fig.2), leaving the other Cumming & Wilson projector as a spare. They also installed Cine-Fi sound equipment, and installed a Christie platter film handling system.

The main fault with carbon arcs was the maximum running time available, which with the current technology in carbons and lamphouse design, was approximately one hour. A change over to the other machine was therefore necessary, to allow replacement of the spent carbons.

The development of the Xenon arc allowed further advances in cinema technology to occur. Once struck, the Xenon arc will continue until the power is turned off, so the development of 'long play' film systems emerged.

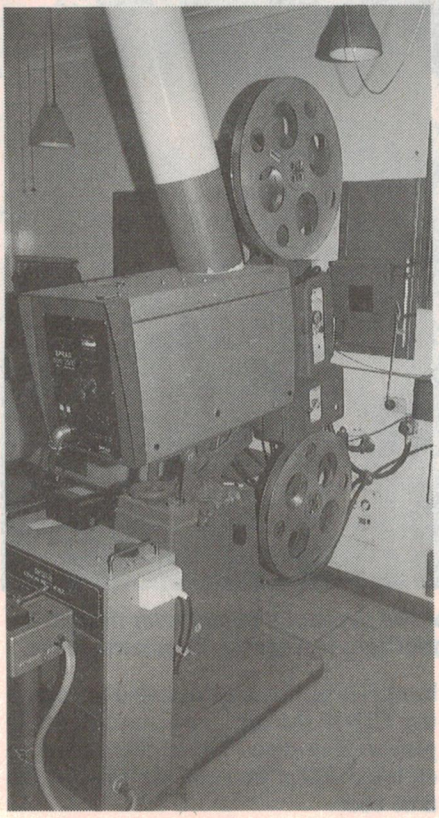


Fig.2: A Simplex Projector with the Xenon lamphouse in place of the old carbon arc. A 'very user friendly' projector.

Platter system

The system that was installed at the Benalla Drive-in is called a 'platter' system, and over years of use in cinemas, this has proved to be the best in respect to ease of operation and film handling. There is no high-speed rewinding of the film when the show is completed, which can cause damage to the film emulsion. On completion of a screening, the film can be made ready for the next screening in less than six minutes.

The platter consists of three or four 1.5m diameter metal plates suspended in the middle (Fig.3) by a bearing, on an arm attached to an upright support post. The plates are placed one above the other. On the top centre of each plate there is a set of feed rollers and a speed sensing arm. Each plate is driven on its rim by a variable speed motor. On the upright support post, there are more rollers and another speed controller.

The film is made up by splicing all the individual spools of the film together, with a special type of clear sticky tape in a specially designed splicer, which trims excess tape and punches sprocket holes through the splicing tape.

All joints are butt joints, cut and joined on the frame lines — not lap joints, as were used during the era when cement glue was used. Cement glue had a habit of coming apart during a show, unless done properly. The lap joins were also noisy going through the projector gate, caused an annoying momentary loss of focus, and were also wasteful of film.

The film is wound onto the platter on its edge, soundtrack down and with markers on the top edge of the film to indicate where the joins are (to assist when breaking the film down again to its original spools). With the start of the film wrapped around the centre ring, the spools are then fed onto the plate, in sequential order until the program is finally assembled.

When the film is ready to be screened, the ring is removed from the centre of the spool. The start of the film is taken up through the feed rollers and the speed control arm, and fed to the projector where it is threaded up as normal and then back to the platter upright, through the takeup speed controller and back onto an empty plate where the centre ring is now placed.

As the projector starts up, it pulls the film through the feed controller — which matches the speed of the film coming off the 'supply' plate to the speed required by the projector. Similarly the takeup speed controller matches the speed of the 'takeup' plate to the speed of the film coming back from the projector. On the completion of the screening, the ring is taken from the

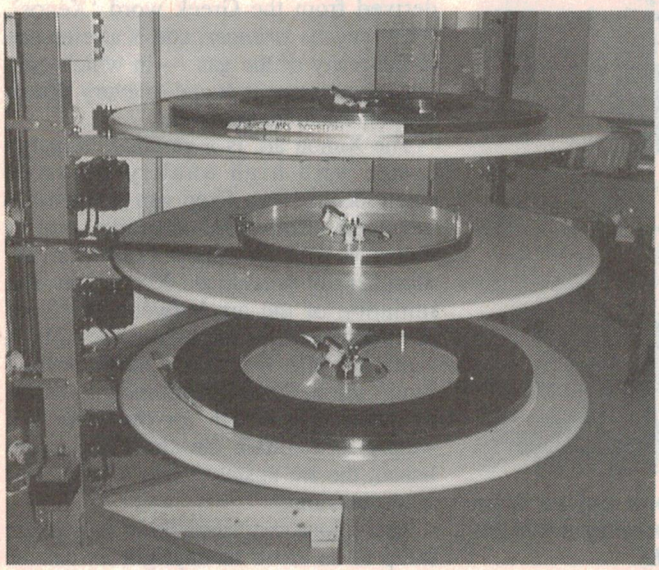


Fig.3: A three tier platter, showing the film being fed from the bottom plate and the middle plate being used as the take-up.

centre of the 'takeup' film platter and the whole process can be repeated, using this platter now as the 'supply' and the original as the 'takeup'; there is no need to rewind. By reducing the amount of time that a film is handled, this system also reduces the possibility of damage.

Cine-fi sound

The Cine-fi sound system was an improvement to the old speaker system that was originally installed at the Drive-in (Fig.4). Cine-Fi used the low level audio to modulate an AM carrier, set at a frequency in the broadcast band which is not subject to interference from local stations or strong interstate stations.

With most Cine-Fi type installations there was the ability to shift the transmitting frequency a small amount, to avoid interference, during nights that a lot of skip was noticeable. The signal was transmitted to the cars by a flexible lead, which was clipped onto the car's antenna, from the stands on the ramps. The soundtrack was then received via the car radio.

Some rows of conventional speakers were left for people who did not have a car radio. The main advantages of this system was the potentially better sound quality produced by the car radio, plus less vandalism and damage caused by people driving off without first disconnecting the speakers. Some speakers used to have a stainless steel wire in the lead, and would make a mess of the side window if you drove off without removing the speaker first.

The greatest problem with this system was the number of flat car batteries at the end of the screening. Jump-starting cars was a common occurrence, particularly during the winter months.

I liked working at the Drive-in theatres. I had the opportunity of meeting and talking to the patrons, and on occasions some patrons would come to the projection room and ask if they could have a look at the equipment running.

The weather sometimes upset a screening, such as heavy rain or fog. One night in showing a dusk-to-dawn holiday screening a fog rolled in, and all the cars moved as close to the screen as they could to see the end of the show. That was all right for them, but I could not see the cue marks on the screen, and had to guess the change-over spots. It must have been a little bit disjointed, but they stopped there until the end...

Another night I started to screen the spools out of order. When it was brought to my attention, I rapidly re-arranged the spools back into the correct order. The patrons must have had a feeling of *deja-vu* as the same scenes were repeated, this time in their correct sequence!

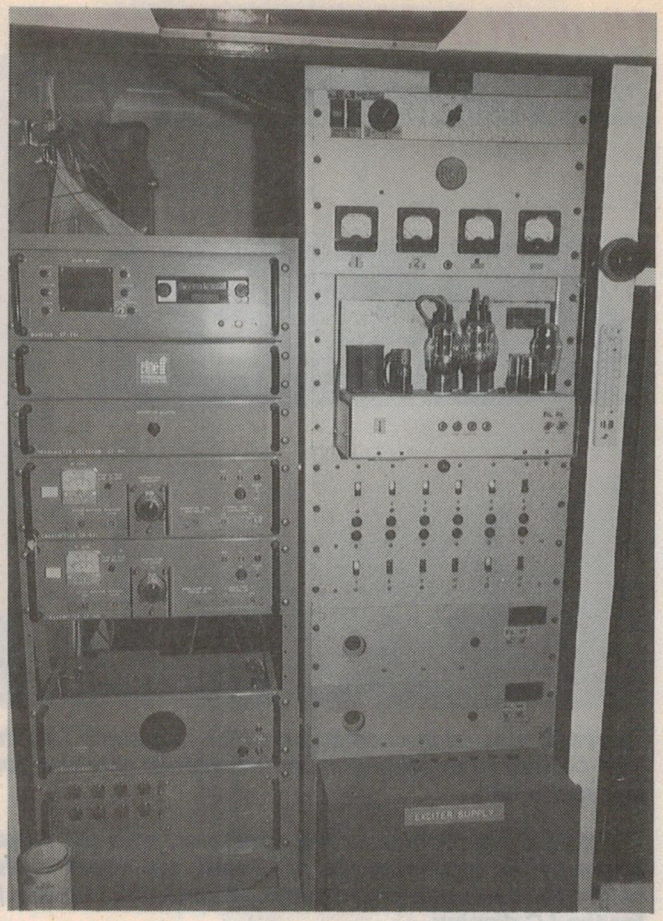


Fig.4: A Cine-fi sound rack as used in drive-in theatres. The two transmitters are in the left rack and on the right rack is the amplifier and distribution rack for the ramp speakers. Note the 807 output valves.

At the end of the show the job I hated doing most was going around the theatre to wake up those who were asleep(?). From a fair distance away, I would shine a high-powered torch into the car, thus saving embarrassing situations to both the patrons and myself.

Another amazing fact that I have noticed about drive-in theatres is that

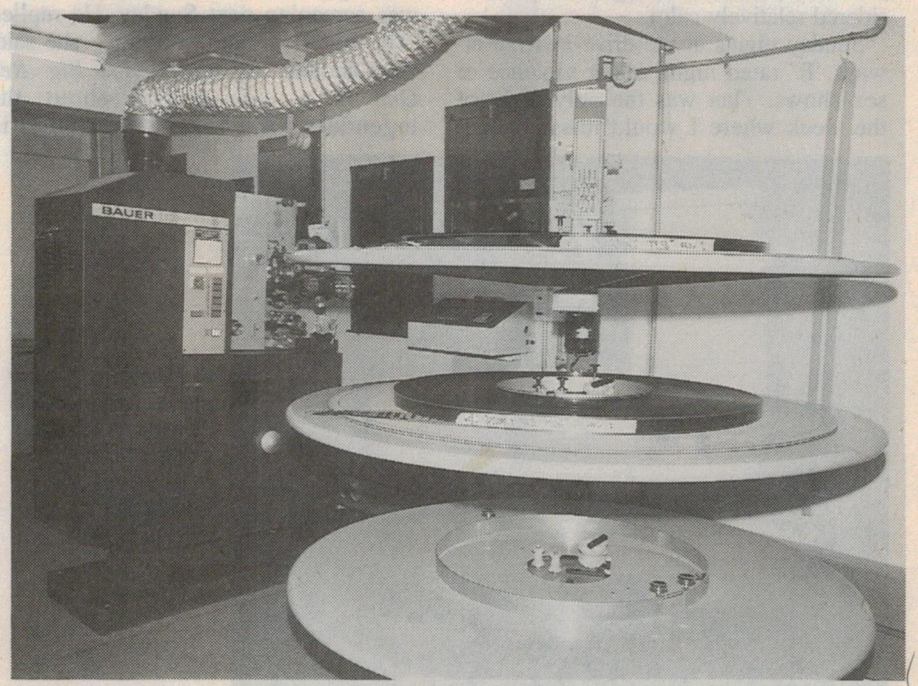
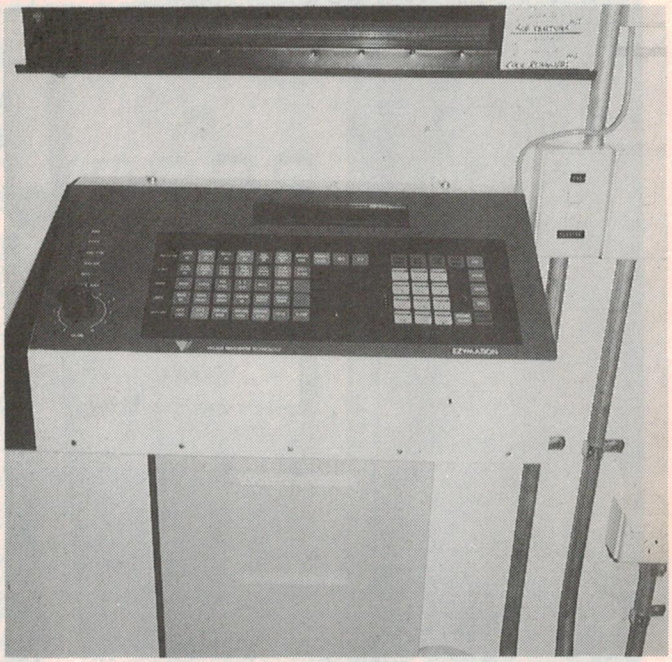
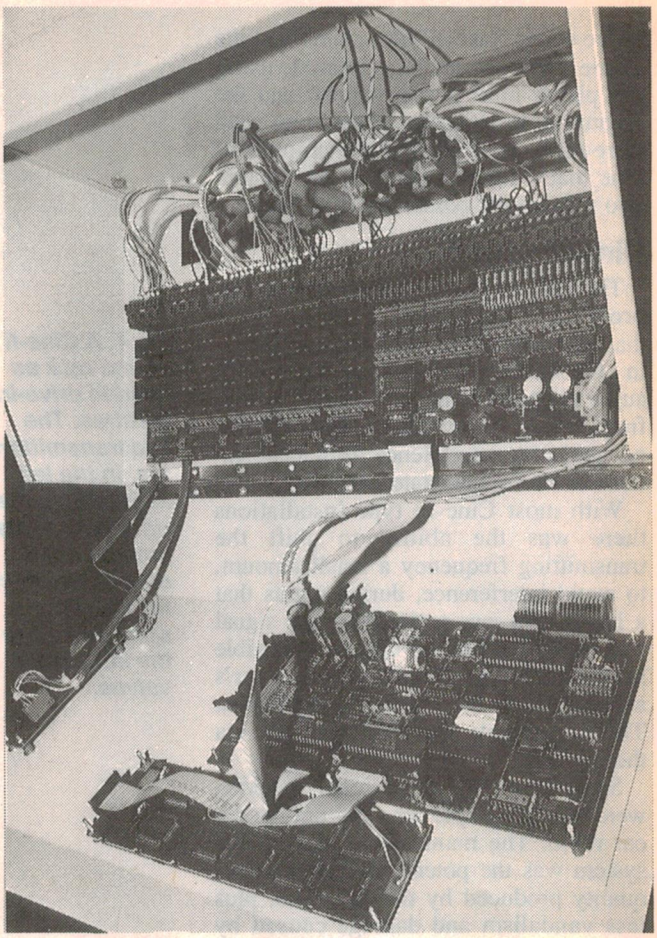


Fig.5 : A typical projection room in an automated theatre. The computer can just be seen under the left hand edge of the top platter. The projector is a Bauer U3.





Above: A view of the computer, which is mounted on the wall between the projector and the platter with the port above the unit.

Right: The electronics of the computer, with the larger board at the top being the I/O board, the board in the centre the computer board and the board at the bottom is for the LC display.

they are all built in a windy area. I've lost count the number of times that I have looked out of the projection room windows and observed the cars moving in the wind, even on nights that I considered relatively calm.

Sunday nights at the drive-in were always 'R' rated night, either violence or sex shows. That was the only night of the week where I would miss changeovers, because I was too busy watching the action on the screen.

The owner's wife was tired of the violence and sex being screened each Sunday, and asked her husband what was screening next Sunday. He replied 'The Big Red One'. "Oh no," she said, "not another sex show." (*The Big Red One* is a war movie, about the legendary First Infantry Division in World War 2, and starred Lee Marvin and Mark Hamill.)

A view of the slide projector and the Tascam 133 tape deck which sequences the slides to the sound track.

Computer control

Having developed the platter long-play system and the Xenon arc, the next stage was to control the screening of the show by a computer. This is the basis of a modern 'multiplex' cinema, where up to six screens (or more) can be run by one operator. The theatre where I am currently working is only a twin, but the principle of operation is the same as for all automated theatres (Fig.5).

The computer in the Capri Twin Cinema, Shepparton is the Model Ezymation II, supplied by Greater Union Village Technology. This unit is designed to automate new or existing theatres. The method used allows any person, without previous knowledge of computers, to enter the program into the computer. This is achieved by each of the function keys being labelled with the traditional terms, with which any projectionist will be familiar (such as 'Xenon on', 'Motor on', etc.).

The computer consists of four main parts: a keyboard, a liquid-crystal display (LCD) screen, a single-board computer and the input/output (I/O) board.

The keyboard is a flat tactile panel

with 'soft touch' keys, that are used to enter the program commands into the computer, or to control the program manually.

The LCD screen indicates the program status — i.e., at what stage the program is currently. This is true both when you're feeding in the program in 'load mode', or when the computer is running the screening in 'run mode'.

The single-board computer interprets the incoming information and controls the operation of the LCD, as well as the input/output board.

The I/O board has 16 opto-isolated inputs for the various cue sensors mounted on the slide projector, etc. There are also 40 relay outputs, which can be set for either normally-open or normally-closed conditions. In addition there are 16 transistor outputs, which can be used to drive alarms, or switch external relays, etc. All I/O lines have a corresponding status indicating LED on the front panel.

The computer can be programmed quite a distance into the future. One day when I was trying to correct the computer clock for daylight saving, I accidently programmed a session for February 27 in the year 2002. It would be a long wait for the start of that session! The computer can be programmed for eight sessions a day. Each session can have a different mix of formats and trailers (e.g., widescreen trailers and CinemaScope main feature, or CinemaScope trailers and Widescreen main feature, etc.)

A typical program would be as shown:

Step	Description
1	Slide xenon on, Start sound slides, House lights preset
2	Stop sound slides, Start auto-start sequence (subroutine — see later)
3	Sound to stereo mode
4	Lights to house down

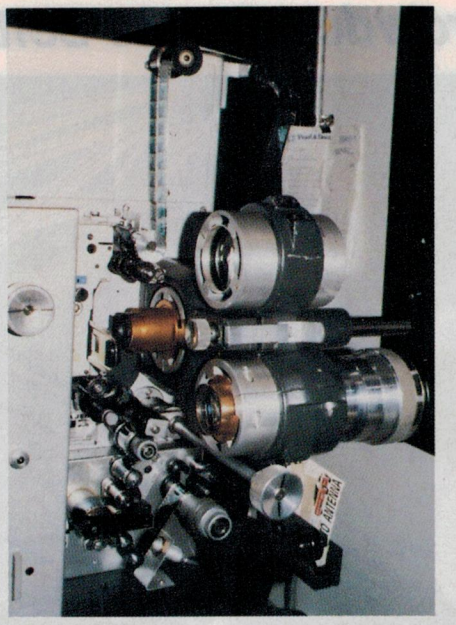


Fig. 6: The lens turret assembly of the Bauer.

5 Lights to house preset
6 Auto-stop sequence (subroutine)

The following shows the timing and steps involved in the Auto-start subroutine sequence:

Step	Time (secs)	Step Description
1	0.0	Sound alarm
2	0.2	Projector xenon on
3	0.4	Masking to Widescreen
4	10.0	Projector motor on
5	13.0	House lights preset
6	14.0	Non-sync sound to mono
7	15.0	Mute non-sync sound
8	17.8	Slide xenon off
9	18.0	Picture on screen
10	19.0	Cycle slides back to start

And here are the timing and steps involved in the Auto Stop sequence:

Step	Time (secs)	Step description
1	0.0	Alarm
2	8.0	Xenon off
3	8.2	Picture off
4	8.6	House lights up
5	9.4	Non-sync sound on
6	9.6	Masking back to widescreen

What all this means in plain English is that when the computer is first switched on at the start of the day, the display screen indicates that the first command it issues is for the house lights and the non-sync sound (which is a six-pack CD player on random play) to come on. This step is programmed to occur 15 minutes prior to the start of the day's screening.

At the programmed starting time, the computer starts the slide machine, fades the non-sync sound down and brings up the sound of the tape deck with the prerecorded cinema advertising. The slide projector that is used in this theatre is a 35mm carousel projector modified to accept a 550W Xenon bulb as its light source. The carousel is stepped by prerecorded tones on the tape. At the same time the house lights are dimmed to a preset level.

When the advertising slides have finished screening, a pulse is sent to the computer to initiate the next stage, which is the Auto-Start sequence (see above). In the next 19 seconds the sound is faded down, the Xenon lamp on the projector is struck, screen masking is adjusted and the projector motor is switched on. The film starts moving through the projector and at the end of the lead-in film strip, another cue mark activates the computer to the next step. The slide carousel Xenon is extinguished and the shutter on the projector opens, putting the image on the screen. The sound is also switched from the tape recorder to the film soundtrack.

Cue marks are placed on the film to signal to the computer when it is to initiate the next step — which in this case is to extinguish the house lights at the end of the trailers/film advertisements, and if the main feature is in the CinemaScope format to open the screen masking, and also change the lens and the aperture plate.

(Unfortunately our projector is not fitted with an automatic lens and aperture plate changer. This procedure is carried out in the low-tech way: we change the lens/aperture plate manually, and can do this while the show is running in three seconds. The patrons do not notice this, as it is done between the fade-out of the trailers and the lead-in to the main feature.)

The next cue mark is placed at the end of the feature, just as the credits start.

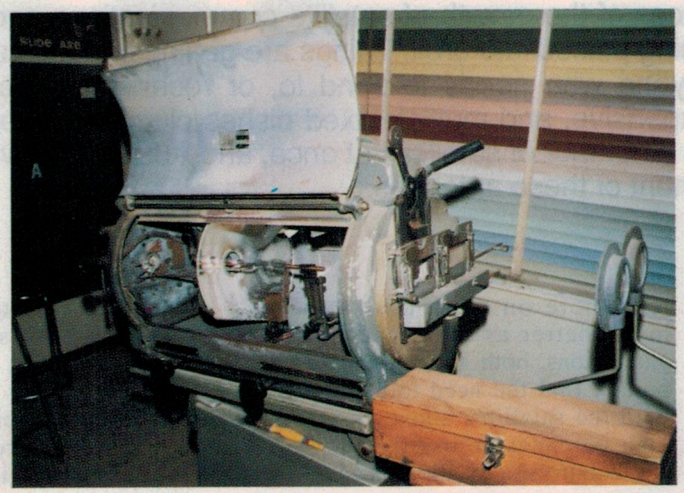
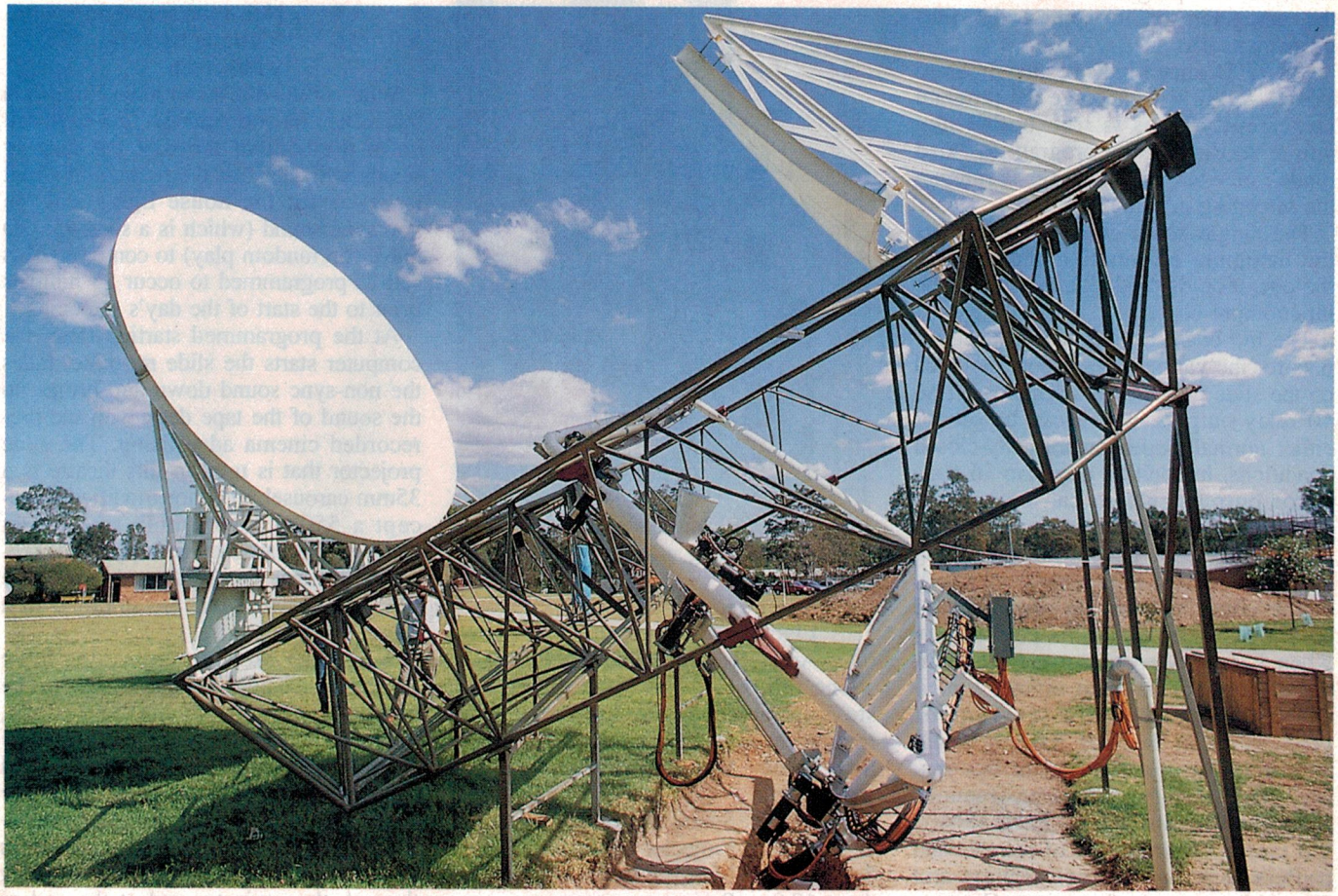


Fig.7: The slide projector used at the Twilight Drive In Theatre, showing the old carbon arc system.

Continued on page 101

Preparing for a crowded Clarke belt:



At the time of writing, the prototype 3.6 metre multibeam antenna was currently operating with only one feed horn. Site: CSIRO Radiophysics section, Marsfield, Sydney.

CSIRO'S LEADING EDGE MULTIBEAM SATELLITE DISH

One of the inevitable consequences of the growth of satellite communications and broadcasting is that more and more 'birds' are being placed into orbit. Things are getting crowded up there, and this is causing complications for anyone who needs to send to, or receive signals from, satellites. Steerable antenna dishes are expensive, and multiple fixed dishes clumsy as well. The answer is one dish capable of focussing on a number of satellites at once, and Australia's own CSIRO is playing a leading role in the development of these antennas.

by BARRIE SMITH

In terms of satellite communication, Asia is the place to point your dish to: the geostationary orbital arc covering this region spans 130° — and in it there will soon be no fewer than 51 satellites, some as close as 2° apart.

With a traffic jam developing 'up top', here on earth things are not much better as more and more organisations, both government and corporate, find the need to communicate with the satellites above us, planting dish antennas across the cityscapes and countryside of the globe.

Pay TV operators, relying for the major part on satellite delivered programming, often kick off their activities without actually locating a receiving dish antenna on their property. A local example of this is Sydney company

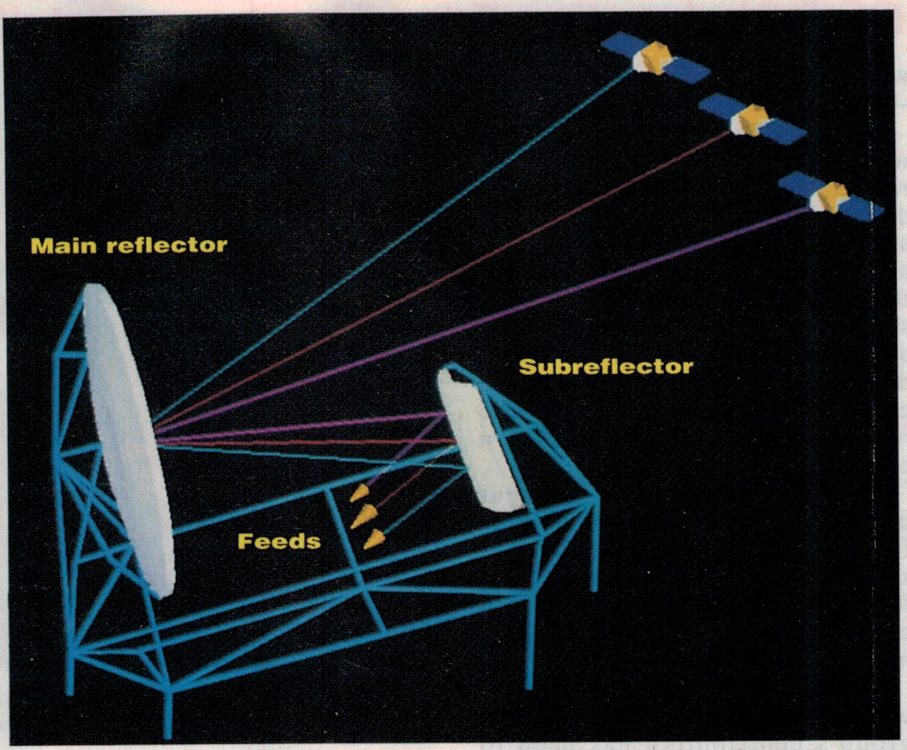
CTS, who rely on satellite feeds from another company.

In Forth Worth in Texas, there are about 30 large dishes on one site — all pointing in different directions and redistributing the signals to organisations across the US. Called a 'teleport', this type of facility will be seen more and more as satellite communication explodes.

Smaller dishes (2 - 3m) are now springing up even in Australian suburban backyards and atop city buildings. As Pay TV becomes a reality, we will hear not only the anguished cries of the visual environmentalists but the sound of descending wrath from our local councils as the landscape becomes festooned with the 'white woks'.

The answer to the problem is already present in the form of *multibeam* dish antennas, able to receive/transmit from and to multiple geostationary and low earth orbit satellites.

In the US there is one company actively engaged in the manufacture of multibeam antennas — Antenna Technology. In Japan, a multibeam dish operates off a Ka-band domestic satellite. It is believed there are only two or three of this type in existence.



The CSIRO's multibeam antenna allows multiple feeds to be used with a single main reflector and subreflector, to receive signals from or transmit signals to multiple satellites.

Australian initiative

For a change, Australia is in the forefront of this advanced technology, with our own version of a multibeam antenna. Developed by the CSIRO, this device is still a prototype, so manufacturing is a stage yet be reached.

Dr Trevor Bird is Research Manager on the Electromagnetics & Antennas Program within the CSIRO's Division of Radiophysics at Marsfield, Sydney. In his view, with so many birds already overhead, the 'one satellite, one earth station' approach is wasteful for many reasons — leaving him with the opinion that "more elegant solutions are needed".

CSIRO development work began on the multibeam antenna in 1985, when the organisation was asked by AUSSAT (now Optus) to come up with an earth station antenna that could simultaneously access the three satellites envisaged to cover this country.

Dr Bird relates that "We looked at retrofitting, so that you could actually have three feeders in one reflector. That works for receive only and for small dishes. But to get the best performance, you end up with a fairly complex feeder and you are still only able to access satellites spaced a couple of degrees apart."

"In the AUSSAT (Optus) scenario you would get something of the order of about a 1 - 2.5 metre dish, which would allow you to access all three satellites. But if there was another part of the segment in Australia that had three satellites, you would have to repoint the dish."

"So then we started looking at alternatives. One was a torus, shaped like part of a donut — circular laterally, and parabolic in the vertical direction."

The CSIRO work group felt there were a number of disadvantages with the torus, aside from its lack of efficiency. Compared with conventional parabolic reflectors that have aperture efficiencies greater than 50%, a torus is less than 20% efficient.

The search was then on for other methods offering higher efficiency, but

In constructing the multibeam antenna, the design took into account that neighbouring panels differ in shape. To mould the aluminium panels a novel adjustable mould was used.

CSIRO's Leading Edge Multibeam Satellite Dish

with maybe not as wide a field of view — that was the trade off.

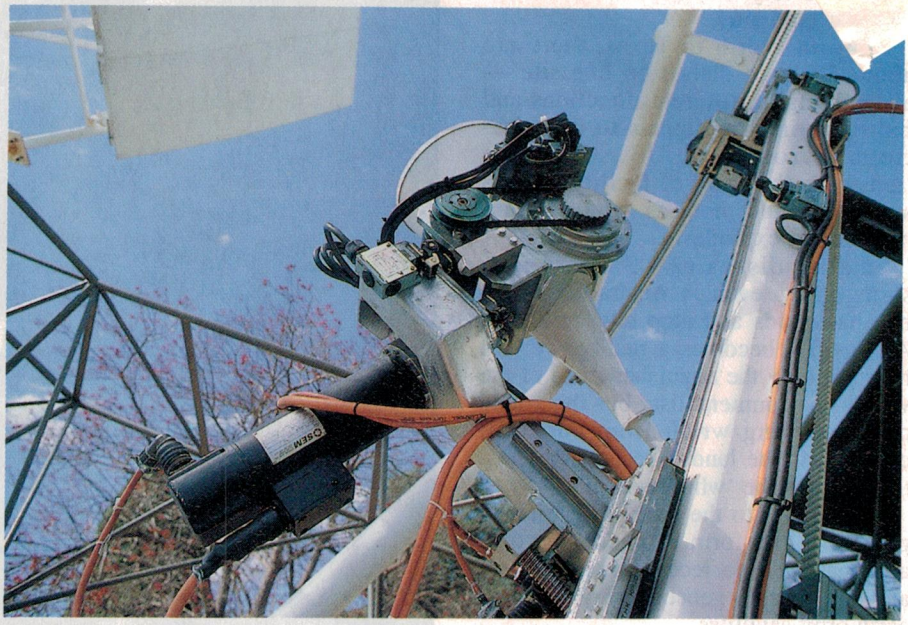
Dr Bird: "The geometry we looked at was a two reflector system, where both reflectors are shaped. Just as with ordinary spectacles, where to overcome astigmatism you can shape the lenses to improve the focussing properties of the eyes, the reflector surfaces are shaped to be able to take beams from a range of directions and to focus them — but they won't be an absolute point focus as they are in a parabolic reflector. Its operation is similar to a collector lens."

The two-reflector arrangement means that instead of having a single focal point, a focal surface or 'hot zone' is created — so by moving the feed anywhere within that zone, you can receive/transmit a signal with high efficiency.

While Dr Bird admits that the concept was not 'invented' at CSIRO, his group's contribution has been to demonstrate that in fact the approach works, theoretically and practically. Another contribution has been to come up with the focal surface, which is ideal for tracking satellites in inclined orbit. The earlier two-reflector antenna, like the torus arrangement, is designed to work best when the satellites lie along the geostationary arc.

Nowadays, many satellites are not fixed in geostationary orbit, but are allowed to wander.

One example is the Optus A2 satellite, which is in an inclined orbit of around 1.5°: from the ground it gives the appearance of going through a 'figure eight' in one day. An operator is compelled to keep on trimming the ground antenna's pointing direction to keep its signal high.

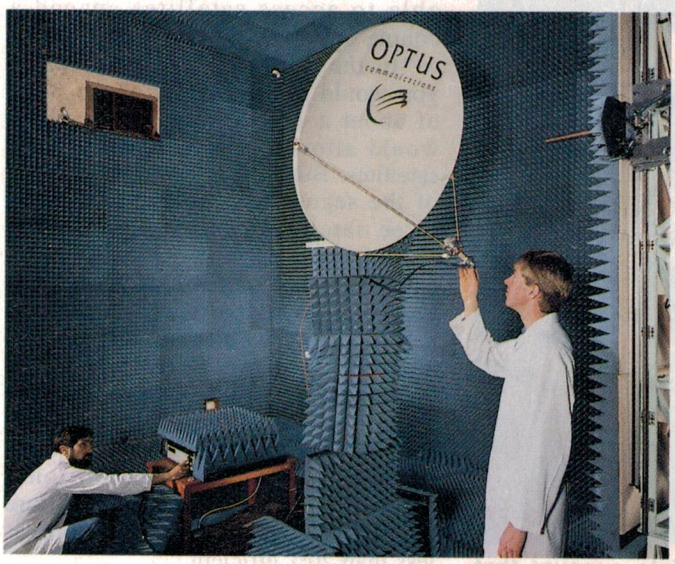


A custom designed steerable feed horn, placed in the focal surface or 'hot cone' of the antenna. Up to 20 could be accommodated in a production model.

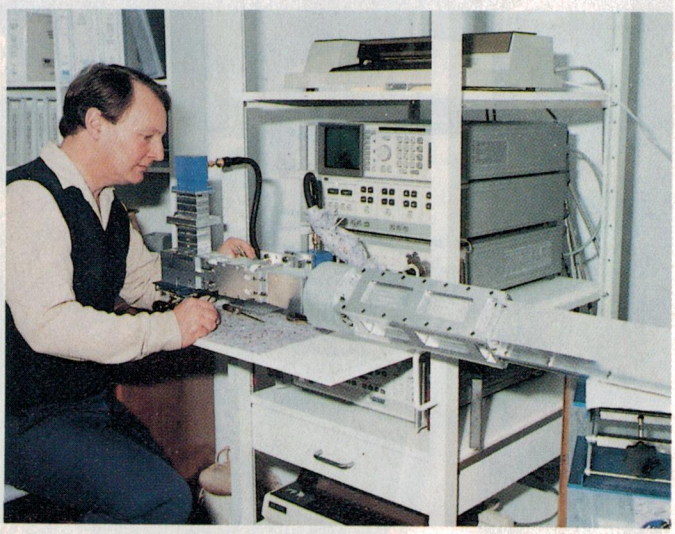
With a conventional antenna you move the whole antenna to follow that satellite; with the multibeam one of the feeds is moved to follow the moving satellite. So, in principle that means if you need to access six satellites with six feeds, some of them may be fixed and some of them may be in inclined orbit — so you can install a mechanism to drive the feeds that are required to track.

Dr Bird explains: "At the moment we are testing a prototype of the multibeam and have devised a technique for moving one of the feeds. This mechanism can be used to track one satellite or it can be driven around anywhere within the focal surface to pick up any other satellite that you may wish. If flexibility is a major requirement, you could sit there and dial in the required direction and the feed will move to that satellite."

Currently, there is one automatic feed in the antenna, but CSIRO has had three fixed feeds installed at one time. One demonstration saw two of the Optus satellites on tap, as well as



A satellite antenna under test in CSIRO's near-field test range in Marsfield, Sydney.



The performance of one of the feed horns used in the multibeam antenna being measured using the CSIRO's instrumentation.

a signal from the Intelsat satellite — about 15° away.

With the current prototype, the feed capacity depends upon the inter-satellite spacing. With 1° separation a total of 20 satellites could be accessed. The antenna's horizontal field of view is 23° along the geostationary arc, permitting a tolerance of +/-1.5° on either side. The dish can also 'look' at satellites which move +/-3° out of the geostationary arc, before the whole antenna would need to be moved.

Perceived markets

The original market for the multibeam antenna was seen as the Teleport area similar to the Fort Worth operation, Dr Bird explained, where the operator provides links to outside companies.

"I think that will happen here too", Dr Bird predicts. "You have only to look at how quickly the number of satellites has grown over this area and in Asia."

"A major obstacle is that with all these dishes sitting on buildings, it becomes a bit of an eyesore. The current scenario is to have six dishes to access six satellites; contrast this with an approach where one dish can accommodate six feeds. In the situation that applies in Sydney, we could cover the whole of the sky with three dishes."

As far as Dr Bird is aware, the only firms currently offering a multibeam in the marketplace are Antenna Technology and the Japanese company.

Current market

There has been a tremendous amount of interest in the Australian development, but the limiting factor is that as yet the CSIRO have only reached prototype stage.

Dr Bird is of the opinion that, if a production model had been available, a number could have been sold already: "We've had several enquiries from overseas suppliers, but getting the finance to progress from the prototype to manufacture is difficult."

CSIRO's multibeam principle

The antenna consists of two reflectors in an offset Cassegrain configuration — plus an array of signal feeds, each viewing a selected satellite. In the conventional antenna the feed must be positioned at a single focal point; the CSIRO multibeam has a 'focal surface' on which up to 20 feeds can be placed.

In the case of the 3.6 metre prototype this focal surface area spans roughly 4 x 1.5 metres. The US Antenna Technology model is able to tap a wider field of view than the CSIRO's — approximately 60°, but produces less gain at every point. In the US design, to lift the gain by 20% you would need to double the size of the dish.

The multibeam uses specially shaped reflectors, strategically positioned to broaden the scan region along the geostationary arc.

To track satellites with this antenna, only the feeds need be moved, rather than the entire structure of the dish. The multibeam can communicate with a number of satellites within one degree of each other.

The CSIRO would prefer to work with an Australian company to bring the multibeam to fruition by licensing the technology. And as Dr Bird, explains, this could happen soon: "We've had some discussions with a couple of companies; one in particular is very interested and they're waiting to hear the outcome of test results on the present feed movement apparatus."

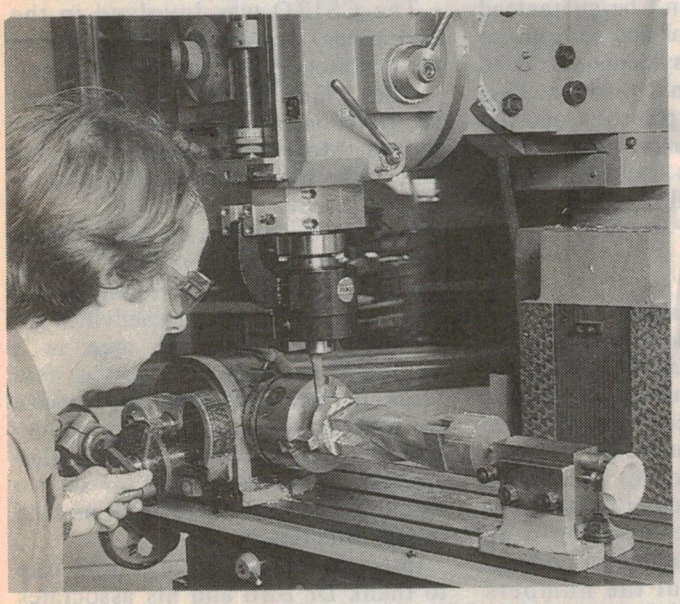
Development resources

Some 'substantial' computer software was used to design the antenna in the first place, Dr Bird explained, but the CSIRO would never have reached as far as it did without the financial support of the Department of Defence, who have seen the commercial possibilities of the antenna as well as its suitability for their own activities.

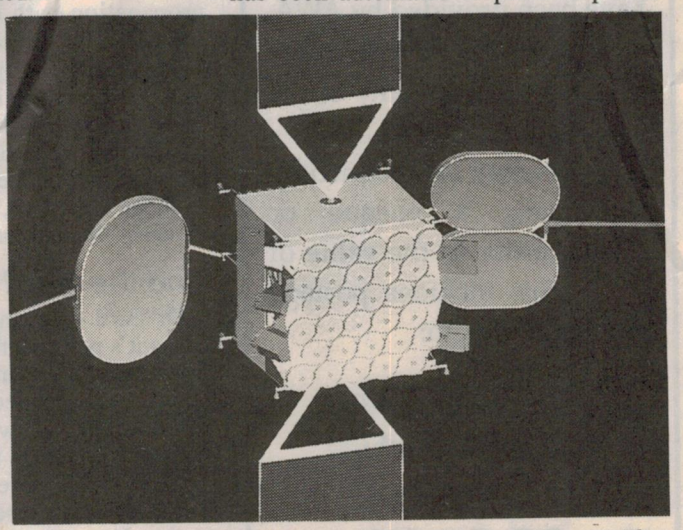
Aside from the CAD work executed by the CSIRO, the feed movement mechanism and the basic idea and concepts behind it were developed in conjunction with a company in Melbourne, Invetech. The Division of Radiophysics built the dish itself in their substantial workshops.

The early 1980's saw the Division design and construct the Australia Telescope's seven-dish array at Narrabri. During this activity the Division developed a technique for producing low cost reflector panels, that has since been used in over 40 earth stations built here and overseas.

This panel technology smoothed the path to constructing the dish for the multibeam. In the latter the technique has been automated to produce panels



The Radiophysics Division of CSIRO has extensive workshops. Here a waveguide 'twist' section is being machined.



A drawing of an Optus section generation B-series satellite, showing the L-band array on the front face, spot beam antennas on the west face (right) and the national beam antenna on the east face (left). The small WA spot beam antenna on the bottom right was designed by CSIRO's Radiophysics.

CSIRO's Multibeam Satellite Dish

of different shapes. In a conventional antenna adjacent rings of panels are all the same; with the multibeam, neighbouring panels may differ in shape. The CSIRO's approach uses an adjustable mould, rather than a series of moulds to form the aluminium panels.

From initial planning the development of the prototype took about three years of elapsed time. Design, construction and testing took about 12 months, preceded by 18 months for the electrical design. Dr Bird admitted "We had to prove to ourselves and also to Defence that the software gave sensible results".

Capabilities and potential

In Dr Bird's view, many operators plan their satellite links on a 'one satellite, one earth station' philosophy. But, he argues, "If you had a multibeam arrangement built into the networking, the cost could be amortised and benefits enjoyed through possible efficiency gains in the network's operation. The other factor is that costs fall for fairly large antennas used in the multibeam configuration — the bigger, the cheaper."

"Once you get above say around 12-metre antennas, which are very expensive to construct, just adding another feed adds little to the cost, compared to the cost of a whole new antenna."

One possibility is that the principle could be used in terrestrial systems, particularly at very high frequencies. At millimetre-wave frequencies, the propagation path can't be guaranteed because of rain storms and so forth, so by using diversity systems you'd be able to get the signal through. One transmitter could be placed at one site and another at a distance; then a multibeam with two feeds could be pointed in those directions, allowing the system to select the optimum signal.

And the cost?

Dr Bird explains about cost: "Because it's new technology, it's obviously more expensive. In fact it's only in the 'boutique' or specialised end of the reflector market, where you would see the cost reductions immediately."

"But, if it were to be made using cheap or mass production type techniques, I'm sure the cost could be reduced to be comparable to conventional dishes — but the numbers would have to be significant, to cover the cost of tooling up for what is a fairly specialised antenna."

At present the auto tracking control is an outside unit, because it's such a big system. The 3.6-metre unit presently being trialled is at the lower end in size. It would be possible, Dr Bird surmises, that you could incorporate control facilities into the antenna itself, consisting of a computer driving the six motors needed.

Because the multibeam is a fixed structure it resembles a building — unlike a conventional antenna which has to move.

Cost savings would be likely; changes in the ground or building surface are compensated for, to a large degree, by the feed movement mechanism.

Related activities

The Division of Radiophysics has, in the past, handled a considerable amount of work for Telstra (formerly OTC), and completed much of the electro-magnetic design for their earth stations, moving on to general work for other earth stations in Australia.

One of these was the complex feed system for the Tasmanian Earth Resources satellite, operated by the CSIRO Division of Oceanography that collects data from the low earth orbit earth resource satellites.

The Division does work on antennas for space applications as well as those on the ground. For example, it has designed and tested the WA spot beam antenna for the Optus satellites made by Hughes US.

The CSIRO was involved in the preliminary design for Optus prior to the contracts going out to tender, following which Hughes commissioned the Division to design one of the antennas. More work has ensued, for one of the US beams, as well as consulting activity.

In Dr Bird's opinion his group's main area of expertise is antenna analysis and design: "We're in the forefront in that area, as far as the research activities go.

The onboard satellite area is a very fruitful sort of area for new ideas. It's not a big area but, because we have expertise in it, we're hoping that when Optus come to do another satellite in the year 2000, or so, we would like to be in there again making our contribution."

In closing, the author would like to thank Dr Bird and his associates for the considerable cooperation given by them in the preparation of this article. ❖

VICTORIA'S SCHOOLS LINKED BY SATELLITE

Late last year saw the official launching of Victoria's Interactive Satellite Television (ISTV) network, which links 2500 of the state's government and independent schools to deliver a wide range of educational services — including language and science and technology programmes. Bayswater firm Melbourne Satellites were jointly awarded the contract to supply, install and support the school satellite terminals, and this along with other Victorian projects has helped the firm achieve dramatic growth.

by JIM ROWE

When Victorian Premier Jeff Kennett officially launched his Directorate of School Education's ISTV Network late in August last year, it was the culmination of a three-year project which had cost $3.8 million.

In the process, not only had Victoria's school students and teachers gained access to a highly effective medium for distance education via interactive satellite TV, but the state's fledgling satellite TV industry had also received a very welcome boost.

Bayswater firm Melbourne Satellites had been awarded roughly half of the contract to supply and install the ISTV school terminals, with the other half having been awarded to fellow Melbourne firm Mobile Television Engineering. And Melbourne Satellites MD Mick Cameron says that the ISTV contract, along with other projects, has allowed his firm to achieve dramatic growth.

In 1993 it had only 3-4 employees and a turnover of around $250,000, while 1994 saw its employees grow to over 20 and annualised turnover to around $3 million.

The project hasn't been of benefit to only the two firms directly involved, either. As much of the equipment and materials required (like antennas and steel mountings) were sourced from other local firms, there's been a significant 'trickle down' effect.

Of course the prime beneficiaries of the ISTV project have been the students in Victoria's schools. Centrally produced language, science and technology programmes can now be beamed directly to the schools, where the students and teachers have been able to interact with the presenters via telephone and fax.

A motorised prime focus dish antenna mounted on the roof of a Victorian school, linked into the ISTV network. The system makes use of the Optus A3 satellite, and much of the equipment and materials used were sourced locally.

To date, the network has offered primary school programmes in science and technology, Indonesian, Japanese and Italian. This year, it's planned to provide a similar range of programmes for secondary schools, along with professional development and training programmes for teachers.

Each of the 2000 government schools and 500 independent schools linked to the network either has, or will shortly have a Ku-band (12.25 - 12.75GHz) satellite terminal based on a Pace IRD50 integrated receiver/decoder, fed from a 0.9dB noise figure LNB (low-noise block downconverter) and a 1.5m dish antenna.

Most of the LNB's are Gardiner single polarity units, while the dish antennas are ESA13-15 units from Andrew Australia, with Az/El mounts and offering 44dBi gain. The ISTV Network operates on the Optus A3 satellite at 156° East, using transponders 5 and 7 with vertical polarisation.

Already, the ISTV project has been hailed as a major educational success, and may well expand from Victoria to most other Australian states. By late in 1994 some 200 schools in the other states were testing the system. The NSW and Victorian governments are apparently negotiating a co-production agreement, which if concluded could result in programmes being originated in both states, this year.

Overseas educational bodies such as Indonesia, The Philippines and France have also shown considerable interest in

The Melbourne Satellites team installing satellite antennas on the roof of the Army's College of TAFE in Bonegilla, Victoria. The College's two Ku-band systems and one C-band system are used to train soldiers in satellite communications technology.

the Victorian initiative, and some of the English-language programmes may be exported to these countries.

In short, the ISTV Network is a great success, and an important achievement by not only Victoria's Directorate of School Education but also its burgeoning satellite communications industry — and firms like Melbourne Satellites in particular.

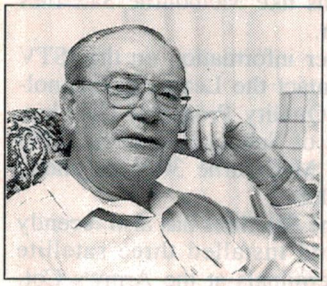
For further information on the ISTV project, contact the Learning Technology Staff, Quality Programs Division, Directorate of School Education, GPO Box 4367, Melbourne 3001 or phone (03) 628 4008.

Melbourne Satellites has also recently supplied and installed three satellite receiving terminals at the Army's College of TAFE in Bonegilla, Victoria. Costing over $20,000, the terminals are being used to train soldiers in satellite communications technology.

One system is for C-band reception, with a 3.7m Orbitron mesh dish on a two-axis motorised mounting feeding a Drake 700e receiver and capable of receiving Intelsat, Gorizonts or Palapa satellite transmissions; the other two are for Ku-band reception and use 1.8m and 1.6m dishes.

For further information on the range of satellite TV equipment available from Melbourne Satellites, contact the firm direct at 82 Bayfield Road (PO Box 901), Bayswater 3153; phone (03) 738 0888, or fax (03) 729 8276.

Our thanks to Mick Cameron of Melbourne Satellites for his help in preparing this story. ❖



When I Think Back...

by Neville Williams

Archie Caswell: radio dealer, serviceman, 'ham' and a modest hero in Japanese POW camps - 2

A local radio dealer and repairman in Queensland during the 'Golden age of radio', Archie Caswell joined the RAAF but ended up as a prisoner in a Japanese POW camp. There he defied his captors by contriving illicit radio receivers, and boosting the morale of his fellow prisoners by intercepting news from allied short-wave broadcasters.

We begin this second part of the Archie Caswell story by letting Archie continue his own account of life in the POW camps:

Life in the Prison Camps was studded with rumours, some to do with the war in general, others to do with matters that might impact on the prisoners' own situation — including our access to radio news broadcasts!

For us, one notably persistent rumour was that we would be transhipped from Java to an unknown destination. As it gained momentum, we decided that the radio facility had best be rendered 'mobile', so a second fake water bottle was prepared to accommodate key spares, including a headphone and a spare valve.

The spare torch cells posed a problem of bulk and weight, but the many empty M&V (meat & vegetable) cans around the camp gave rise to an idea. Two such tins, cut around the middle, could be fitted together to look like an unopened can. A circular tin sleeve soldered on the inside would ensure a neat fit and the original label could be re-glued around the circumference to hide the join.

As I remember, the 'doctored' tins held seven torch cells each, which had to be carefully insulated from the top and bottom of the can. The weight was about right, and quite a few such tins were prepared to ensure a continuing source of power.

The one disadvantage was that they became quite heavy on a long trek, as Bill Wilkinson (RAAF) later discovered, when he subsequently inherited the job of carrying quite a few of them.

The second fake water bottle was to be carried by Bill Breillat, while I would look after the radio and aerial. Little did we realise then that this 'mobile' outfit would ultimately travel from Singapore to Burma and Thailand.

As it was, the new receiver had an extended tuning range and passed all tests, news being received from San Francisco, the BBC, All-India Radio Delhi, and Radio Australia Melbourne.

Because we had to conserve batteries, it was decided that the best regular bulletin was from the BBC Far East transmissions. There were times, however, when it was not possible to listen because of Jap guards, camp shifting etc. For the most part, listening had to be done in the dark and notes made on paper, which took some deciphering in daylight.

Time to move on

The precautionary measures certainly paid off when rumours of an impending shift proved to be true: within a few weeks, we were to leave the 'Bicycle'

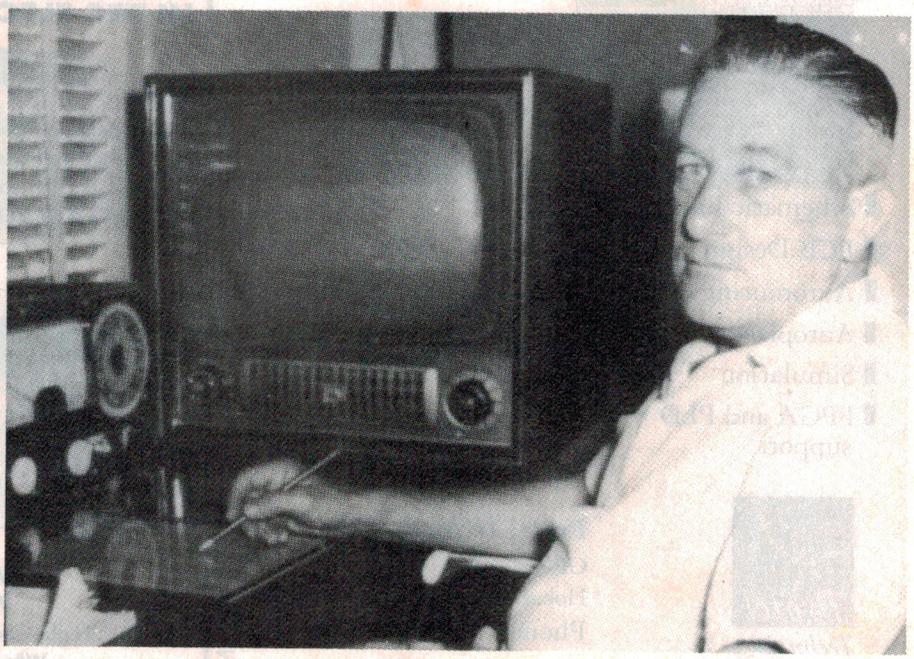


Fig.1: Archie Caswell, photographed just before his retirement at the test bench of his shop in Adelaide Street, Maryborough. He had been involved in television from its establishment in Australia in 1956, when he discovered that signals from Melbourne could be received in Southern Queensland due to anomalous 'skip' propagation.

Camp, Java — destination unknown, but perhaps Singapore. The day came and we were loaded into a Jap cargo vessel (bought from Britain pre-war as scrap metal). The space per person was two square feet per man, which made for a rather 'cosy' crossing of the equator!

After quite a few days of hell, we reached Changi camp in Singapore. This, we soon learned, would be only a staging point, so the radio was not set up. Moreover, someone else at Changi already had a hidden radio and news was being received.

A couple of weeks later, we were herded into a cattle boat and on our way again, this time on a longer and more arduous journey — the conditions filthy and the progress slow — and with everyone sweating it out under the steel deck plates until Rangoon, Burma was reached.

Someone on board had a compass and could check our direction of travel. We reasoned that we must be nearly there, when a deck party saw the muddy water of the Irrawaddy Delta.

There followed a slight respite — of one day — and we were on our way again from Rangoon to Moulmein, Burma. Here we were marched off the ship to the Moulmein jail. An ever to be rembered sight was the 'Golden Pagodas' glistening in the sunshine, followed by the sets of stocks just inside the jail gates, and the rack and other medieval means of torture.

This gave us cause to think hard, as also did the sight of primitive Burmese tribesman prisoners walking around the courtyard with heavy chains around their ankles and holding in their hands a heavy iron ball chained to their ankles.

That night, we nevertheless decided to throw caution to the winds and set up the radio, receiving two news broadcasts.

Burma/Thailand railway

Within 48 hours, the move was on again and we marched away through the outskirts of Moulmein to a place named 'Thanbiziat', which was eventually to become the Burmese terminal of the infamous Burma/Thailand railway.

On the march, we were most impressed by the friendliness of the Indian/Burmese population, who tried to give us food, towels, clothing and books, risking the every-present chance of a good Japanese flogging. Many of these people spoke fluent English and were obviously well educated.

The radio was re-commissioned during operation Thanbyuzayat Burma but, applying our Java lesson, all news went only to a senior officer, who arranged distribution.

A week or two here, and many Japanese indoctrination lectures later, saw us off again some 40km into the jungle towards Thailand. We were indeed going to build a railway, of which much has been written.

Some weeks passed during which the radio intercepted many cheerio calls from relatives in Australia and as reception occurred in darkness, quite a few messages were delivered to POWs from their familes Down Under. This boosted their morale and gave them some hope.

Unfortunately, over-talkative individuals in our midst were still less than discrete in discussing such matters, and the Japanese were becoming frustrated because they could not find the radio they thought we must have access to.

A change in strategy was clearly called for when it became evident that water bottles were being used freely by many POWs to conceal watches, jewellery, etc that they had managed to scrounge. The Japanese were walking through our huts saying: "Changee, changee, ten rupee for watch, compass, radio, etc".

They had even stripped our camp of old lengths of fencing wire, in the search for radio equipment. What if a curious guard chose to examine one of our two 'radio' water bottles?

Seat of the problem!

After some discussion, we decided to make a wooden kitchen stool with a false bottom and conceal the radio and batteries there. (For Archie, it was also a place where he could conceal his war diary).

The ruse completely fooled the guards, who frequently sat on the stool

Fig.2: Having defied his captors in Japanese POW camps at great risk to his life, a once ordinary country radio serviceman set about rebuilding his life in this equally ordinary radio shop in Adelaide Street, Maryborough, Queensland.

when searching our gear. When shifting camp, the stool would be loaded with the kitchen gear and away would go the Jap guard on the back of the truck — sitting on the stool! Needless to say, the opening was nailed shut when a move was on.

As the months dragged by, we shifted back to the 26 Kilo Camp in Burma, then off again to the 55 Kilo Camp and then to 75 Kilo and on to the 105 Kilo Camp, which was just outside the Thai border. It doesn't sound much when you say it quickly, but it represented 18 months of life in the jungle.

The radio still performed well, in spite of the humidity. Unfortunately, as the 105 Camp, we lost our good friend Frank Huxham with dysentery.

The railway line was now finished. Other parties had been working from Bangkok and when the last rails were laid, we watched the spectacle of Japanese troops going north and wounded going south. Japanese propaganda was intense at the time, but they couldn't fool us. It was evident that their time was beginning to run out.

However, the constant humidity was taking its toll on our stock of batteries; what else could one expect after four or five months of continuous rain?

Eventually the rain cleared, but our power supply was in poor shape. Brian suggested that we replace the battery paste with a mixture of sal-ammoniac and rice flour. Some cells were duly rebuilt and rejuvenated, although rendered very messy to handle.

Made life bearable

The crisis proved a point, however: it demonstrated that the radio did boost morale and dissuaded many from attempting escape into the jungle. We knew that the nearest Allied forces were 400km away, and no one could be that lucky to escape and remain undetected.

The few that did try to escape were brought back to camp and either shot or beheaded without any semblance of a trial.

It must have been 1944 when we again shifted camp, this time into Thailand, and down eventually to Tamarkan, where we were greeted by old friends.

On entering camp our Commanding Officer told us that it was time to give the radio up, as the Japanese Kempi Tai (Military Police) were active and we had pushed our luck long enough. Some Englishmen at a nearby camp were operating another secret radio, so I surrendered ours to Smithy who buried it in the kitchen. It is probably still there today!

In conclusion, we must remember that this project, like many others, could not have made itself worthwhile without the effort of many people who, working as a team, ensured its successful operation.

Arch Caswell concludes his memoirs with the sentence: *My gratitude to all who contributed.*

To that I should add my own word of appreciation, for the effort he made to record the events for posterity. As Darryl Kasch remarked to me over the phone: "Arch wrote what he did only because he was prevailed upon to do so. He confined himself to the basic facts, anxious to avoid any fuss about events that he would have preferred to put behind him".

Archie Caswell, postwar

In the taped interview, Archie's wife Desley said that when the War ended in August 1945, priority for transport back to Australia understandably went to those POWs whose physical condition was the most urgent.

Archie did not make it back until October, but even though he had been looked after in the meantime, he still weighed only 6-1/2 stone. His health was 'not good' and he had to be cautious about what he ate. On arrival, he was immediately admitted for a repatriation hospital 'check-up'. His doctor warned him that the effects of extended malnutrition would probably linger for the rest of his life, and that his treatment would continue for as long as it took to confirm his pension rights followingdischarge.

When he ultimately did return home with a pension of ten shillings ($1.00) per fortnight, he was impatient to pick up his business life where he had left off and start a family. The Caswells had two daughters, Jennifer and Lyn.

Archie's attitude was simply that his POW experience had cost him the best part of four years, and he wasn't about to extend the loss by dwelling on the past. He'd prefer to 'black it out' and carry right on.

In fact, Desley says, he made light of medical advice to 'make haste slowly' and may well have overdone things applying himself to his business, postwar — 'head down and tail up'!

The one person he would stop and talk to about the war years was his old buddy Fl.Lt. Ken Smith. It was Ken who perhaps more than anyone else, alerted his family to the fact that Ken had a story to tell, and who finally constrained him to put pen to paper.

In the meantime, Archie had been awarded the British Empire Medal by the Governor General (Mr McKell). The citation read:

Caswell, when captured at Java, displayed considerable initiative by building from scrap components a wireless set. He operated this under great dif-

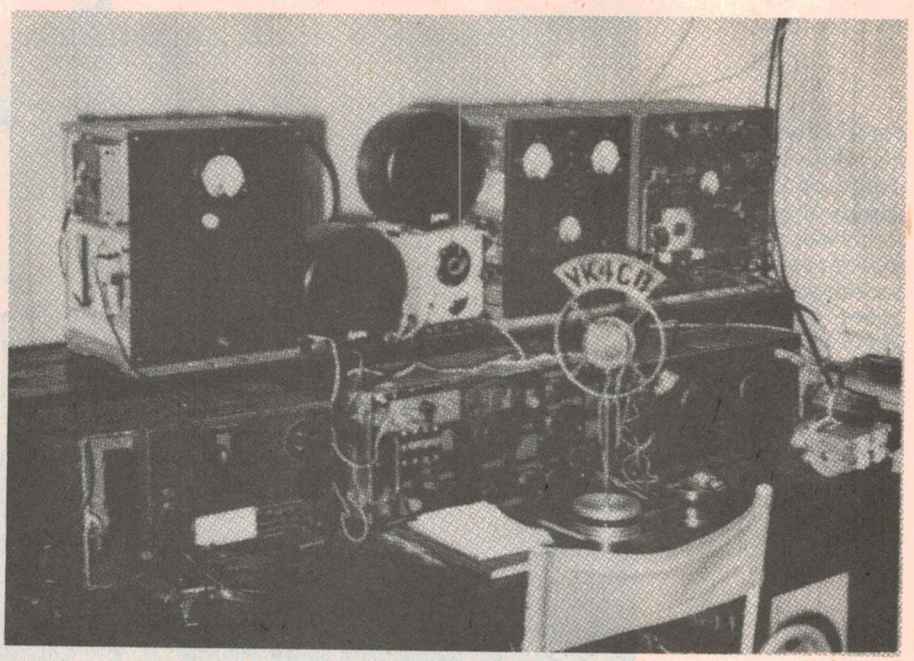


Fig.3: Arch Caswell's amateur radio at the rear of his home. Note the Reiss carbon microphone, surmounted by the callsign VK4CB.

ficulties and the threat of severe punishment if he were caught. He worked the set continuously to supply a news service to all his comrades.

These services were continued when he transferred to other camps, by smuggling the radio with him.

Newspaper report

In reporting the above, and presumably quoting from official records, the current *Maryborough Chronicle* explained:

At the end of this course (Radar at Sydney University) he was sent to Singapore to install radar equipment in Lockheed Hudson aircraft, and posted to No.1 Squadron.

After three months in Singapore, the squadron was transferred to Sumatra about a week before capitulation. Here the squadron continued operations against the Japanese on the Malay Peninsula. The squadron at this time operated from Palembang, in the south of Sumatra.

Mr Caswell modestly remarked yesterday that when he heard he had been awarded the British Empire Medal, he was surprised.

To date, he has not received any information about the award other than what he read in the paper.

Darryl Kasch was given to understand that Archie did not display or talk about the medal, nor would he have welcomed suggestions that his activities could provide the central theme for a book on forbidden radios in the POW camps.

Did he know the celebrated Dr 'Weary' Dunlop? According to his wife Desley he did, although not so much as a Dr/patient.

Knowing that Archie needed time, on occasions, to work on the radio project, Weary Dunlop would conceal him amongst the men who were 'obviously too sick to work today'. Once the guard's back was turned, Archie would head for the soldering iron!

Author Bon Hall, himself a one-time RAAF Flying Officer and POW in Burma, had seen at first hand the efforts of Archie and others to intercept and disseminate news to the many thousands of prisoners in the adjacent POW camps.

In a separate article in the *Australasian Post* (28/8/1960) Bon Hall — himself a former RAAF officer and POW — said that to be caught with a radio would have involved collective penalties for the prisoners generally and an automatic death penalty for those immediately involved.

Summing it all up, Darryl Kasch, who collected the relevant material, remarked: "Archie Caswell obviously wasn't a medal man!"

First and foremost, he was an industrious country radio retailer, intent on rebuilding a business based on post-war receivers and providing for his wife Desley and two daughters Jennifer and Lyn. Desley says that she was very much a part of the enterprise, standing in at the shop, answering the phone and looking after the books.

Roving around

Integrated with the shop was radio servicing, involving calls up to seven days a week, with distant jobs shuffled to the weekend so that out-of-town journeys could be converted into family outings. Archie also had a shared interest in new car sales, and last but not least, remained a keen amateur radio operator with but one reservation in the immediate post-war period: he would rather 'pull the big switch' than stay around and respond to an amateur with a 'JA' (Japanese) callsign. Funny about that!

DX on 144MHz...

Writing in the Maryborough Chronicle, Bill Rendall emphasises that Arch Caswell's success in snaring signals from Melbourne's Channel 2 TV station was not a matter of chance.

Some years before, he had maintained a nightly schedule with another amateur station — 4JO at Clayfield Brisbane — to demonstrate that reliable contact was possible on 144MHz using the relatively low power of 20W.

Arch reasoned that with a much more powerful signal of lower frequency, a lofty directional antenna and a path free of intervening mountains, there would be a good chance of the TV signals reaching the Maryborough area. They did!

The post-war business was based at a shop in Kent St, Maryborough but, following a flood in 1955, he transferred to a site in Upper Adelaide Street. Competition in the town became quite fierce, according to Darryl Kasch, with Keers Radio across the street pushing Philips products against Arch Caswell handling mainly Astor, with a sprinkling of other brands including Tasma and Breville.

As such, the business proved quite successful. According to wife Desley, they were both busy and didn't make a fortune — but neither did they want for anything. They employed a youth, Jack Lloyd, to help out and operated a utility and a Vespa motor scooter for delivery and service work. The scooter rated a special mention because it provided a 'fun' way for Dad to 'double' the kids to school — this in the days before strict road rules about safety helmets, etc.

By the middle 1950's, the family doctor was becoming more urgent in his warnings to Arch Caswell to slow down, and to Desley his advice made good sense. So when a local estate agent mentioned that a radio dealer/repairman 'Les' — himself an ex-serviceman — was seeking to re-locate in Queensland, Desley prevailed upon her husband to sell out.

Her aim was to break the tight cycle of committments in which they were enmeshed. If Arch chose later to resume his radio activities on a less hectic scale, so be it. In due course the documents were signed and the business changed hands in 1956.

'Spare time' servicing

In fact, Arch never did re-launch into radio sales and service at a serious level, but neither did he drop out of radio altogether. He did a few repair jobs 'to keep his hand in' and showed a special interest in ageing receivers which were in the process of becoming historic or 'vintage' models. He had also taken up lawn bowls, which he had pursued to championship level.

And, of course, out the back he had an array of amateur radio equipment and motor-driven rotating antennas, atop a 70ft (21m) mast. Desley recalls that the girls used to come in and observe that "Dad's talking to his girl friend again — up in the Canary Islands"!

That same mast brought a new and compelling interest into his life when the ABC TV stations in Sydney and Melbourne opened in November 1956, in time for the Melbourne Olympics. To his delight he found that, under certain atmospheric conditions, the signal — particularly from Melbourne — 'skipped' through to the Maryborough area.

So Arch bought himself a standard Australian TV set (did somebody say Astor?) and set it up in his home. When signals showed up on the screen, the word would go out and friends and relatives would converge on the Caswell home for free entertainment. Sometimes they would see a whole show; at other times there would be a loud 'Hisssss' and the picture would dissolve into nothingness as the skip path disappeared.

The exercise also meant that Arch was able to gain an early familiarity with television technology, as employed in the initial wave of Australian B&W receivers.

As TV services were extended into Brisbane in the following years, intending viewers in the Maryborough area faced the option of installing 'fringe' TV antennas on lofty, guyed masts, much as happened in the Newcastle area of NSW.

Fringe area TV

Arch Caswell responded by setting up the family caravan on an accessible site and providing it with mains power, a TV receiver and a fringe-type antenna. By arrangement, would-be viewers could meet Arch there at mutually suitable times and see for themselves, in a rural family setting, what was involved in the then-new and unfamiliar form of entertainment.

In due course his eldest brother George, who was marketing TV receivers in the Murgon area, commissioned a TV service van with a telescopic antenna system, which could check signal levels at customers' own homes. Arch lent a helping hand when necessary and also helped out with TV servicing jobs.

He and Desley also helped family members in the car business, sometimes forming a party to ferry new vehicles up from Brisbane — a tedious business for both themselves and other road users because they were not supposed to push new and 'tight' engines to beyond40mph(69km/h).

Pre-war, Arch had always been a 'Chev' man, but after the war he settled for the Chev's big brother — an ex-disposals Pontiac.

This was followed by a new Chevrolet, after which he had to transfer his affiliation to Holdens. Holdens were OK, but he couldn't say the same for their English cousin the Vauxhall — which, he claimed, used to pitch and 'bucket' along Australian country roads.

The Holden 'Brougham' earned high marks, because he saw it as a scaled-down Chevvy. Jap cars didn't rate, on principle, and only right at the last did Arch and Desley settle respectively for a Datsun and a Toyota!

As the 1970's gave place to the 80's, Desley sensed that her husband was feeling his age. They had retired to an eight-acre property for 'peace and quiet' but even with a ride-on mower, Arch could not keep it tidy to his liking. His beloved lawn bowls slipped from competitive play to a social game one day a week. And, for whatever reason, his sight had deteriorated to the point where he had no hope of coping with transistorised equipment.

Final, fatal blow

Then in early 1986, at age 72, he was diagnosed as suffering from a melanoma, possibly from the years he had spent outdoors in Burma — his naturally fair skin often protected only by a loin cloth.

He entered hospital in April 1986 for an operation, which appeared to be successful. But the doctors misread the signs, compounded by Archie's own diffidence and what was diagnosed as a harmless residual cyst proved to be malignant and invaded his lymph glands. He died in November 1986 at age 73.

I can pay no higher tribute than to remark that Archie Caswell had been an associate of the late Dr 'Weary' Dunlop on the infamous Burma Railway. But while his contribution may have been less dramatic, he was certainly made of similar material! ❖

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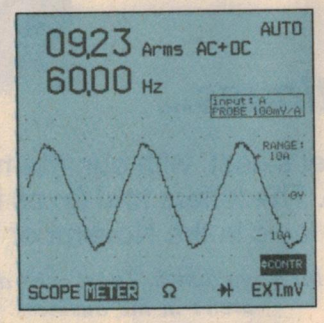

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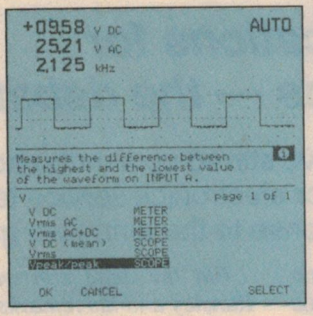

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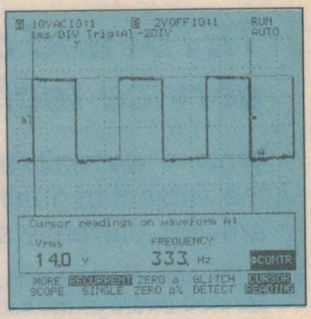

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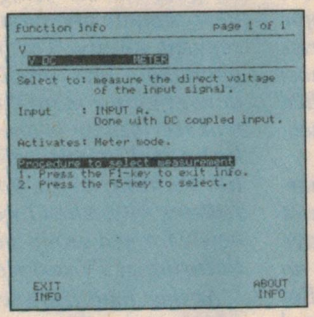

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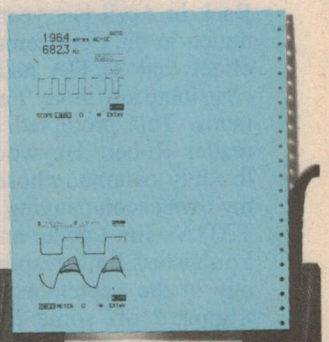

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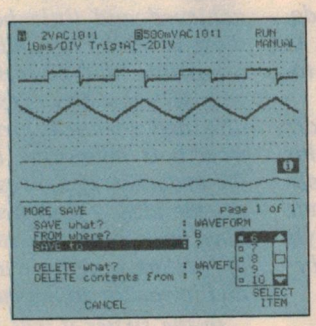

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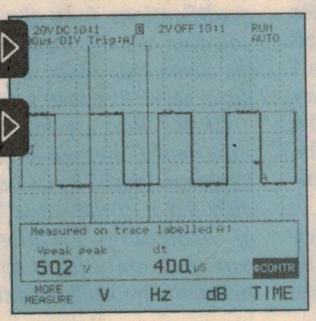

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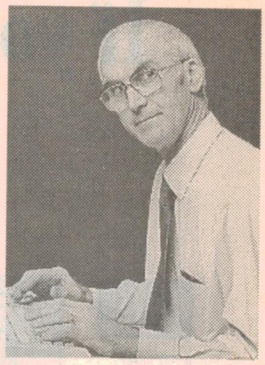


TETIA and qualifications for service technicians — the debate continues...

Wow — we really seem to have stirred up a metaphorical hornet's nest, with our attempt to discuss the subject of qualifications for electronics service technicians. The letters and faxes have kept on arriving, currently still in response to the airing we gave to the topic in the November issue.

I'm sure most readers of this column are well aware of the background to this topic by now, but here's a brief recap. Back in April last year, we published a notice in the Serviceman column to the effect that TETIA had decided not to contribute any more 'Fault of the Month' items. This prompted a response from reader Robert Heywood, published in the July column, whose comments (and my own accompanying comments) upset TETIA's Jim Lawler and his colleagues. I published Jim's response with an apology in the September column, but this triggered off some further responses, which were published in the November column. And these in turn have spawned responses of their own, some of which I presented for your interest in the January issue. (It's all starting to seem a bit like one of those Russian 'Babushka' dolls, isn't it? Each one you open up has another one inside it.)

Anyway, that's a precis of the story so far. Now let's re-enter the fray, with a letter from — wait for it — Mr Robert Heywood.

No, it's not the same Robert Heywood who wrote the original letter last July, but his father Robert Heywood Senior, who apparently runs a servicing company called Rutherglen Technical Services in Rutherglen, Victoria. And not surprisingly Mr Heywood Snr is seeking to defend his son, in particular with regard to some of the criticisms made by TETIA member Mr A.F. Ransley, in the November column. So in the interests of fair play, here's Robert Heywood Snr's response:

I fancied hearing a rattling of old bones when reading my son's letter in your column. Subsequent issues proved my clairaudience. His comments not only bought an argument, but also unwittingly breathed life into what I had thought to be one very dead dog.

But the dead can wait. First to Mr Ransley and his remarks.

His sarcasm is poor argument. I, too, find it a pity when incompetent people cause problems. From customer's stories over the past 30 years, I have found most problems are caused, not by 'qualified hobbyists', but professional servicemen, some of them members of TETIA.

Silly remarks about multimeters notwithstanding, I considered my son one of my better apprentices — and I have trained many. Unlike myself, he has no formal qualifications in electronics. But then, if you subtract my own original qualifications from the work I now do, you find we are equally unqualified, in the same way many of the people in today's service industry are.

(If Mr Ransley has indeed 28 years experience, then no doubt he learned his trade on Astor SJ's as I did. And he probably did it at the same 'leading Institute of Technology', whose teaching style was then aptly fitted to its location between the museum and the brewery.)

Learning process

Electronics is an applied science. How it is learned is hardly important. Like most of us, my son's experience in electronics and servicing has already outstripped anything he could have learned at TAFE. I also suggest that Mr Ransley, like all others in the service industry, did, in fact, gain a certain amount of his early experience through trial and error, and often at the customer's (or the boss's) expense. To have 'done it the hard way in a retailers workshop' and not admit this fact is rather silly. 'Been there, done that!'

I am glad he uses quotes over the word 'Qualified'. For, unlike the science of electronics, servicing is an art. It can only be learned by experience, and like other arts, preferably under guidance. Those who doubt this simply aren't in the business. How and where we gain our servicing experience most likely counts for about half of our subsequent ability. The rest is dependent upon type and intellect. There is no doubt that the more than merely competent serviceman is one of the most intelligent and creative of people, and here lies the irony of his position; one of the reasons why, when I was my son's age, a newly formed group was pushing for the licensing of TV servicemen.

At that time there was a general dissatisfaction with awards. Nothing was achieved and little has changed. But those in the service industry at least saw a possible 'out' in licensing. The notion was seen for the essentially unreasonable and unethical grab for loot that it was. It is interesting to note, however, the evolution of the reasons used to justify the idea — couched, as they always have been, in the breast beating rhetoric of 'getting a better deal for the public' and 'cleaning up the industry'.

In the sixties it was a grab for status and money, nothing more. At a time when the electronics tradesman saw his 'unqualified' colleagues in the public service, banks and retailing receiving wage increases through seniority alone and saw his mates in other trades taking home pay packets he could only dream of, it was to be expected. His trade was considered merely an extension of the metal worker's and he was paid a fitter's wage, one of the lowest in industry. Too highly qualified to be satisfied or even wanted on the factory floor, he sought his fortune elsewhere, often in retail servicing. But the spectre of his lowly status haunted even the newest and brightest of workplaces, let alone those dank lean-to's attached like barnacles to the rear of electrical retail stores, where so many of us plied our trade.

Now, at a time when increasing complexity and reducing intrinsic value have removed all but the experienced diehards and the newly competent from the industry, the proponents of licensing are telling us the public need to be protected from unqualified people? Come on. That was a fact years ago, when anyone who had ever built a crystal set reckoned he could change a few valves and get a piece of the action.

No, the push for licensing comes down to the same old things: the prime directive which can be inferred from Ray Banks' letter (strains of an old Abba song here, 'Money, money, money...'), and the desire for self image verification.

This is where the whole shoddy mess comes to a head; where any mention of qualifications is like jumping on a bull ant's nest.

There is no doubt that if the electronics industry had never accepted the silly, hierarchical qualification structure bequeathed to it by the 'bums on seats' attitude of our educational institutions, and if industry had recognised and related the skill of the electronics tradesman to something nearer its proper level, we wouldn't have the ego problem. But the real tension lies in the fact that electronic servicing is a skill, where competence and knowledge are not reflected by educational qualifications.

Rhetorical or not, Mr Banks' questions of who should be allowed to fix what stem from a misguided perception of technical competence. Either a person has the experience or he doesn't, and this has little to do with qualifications. Sure, I expect a technician to know his electronics, then with time he will become competent in any area of the trade. Just as most of us have.

(In this regard it is also interesting to remember that most cassette, video and disc player faults are mechanical. Include in this the dj's, blatantly obvious burn outs and tube faults in TV's and it doesn't leave much for our hard won knowledge of the latest electronics.)

But you cannot license for competence any more than you can discern its existence from the results of a memory test. (What waveform do you expect here...? Indeed!)

It is in the nature of the serviceman to look down upon others in the industry. If you don't have solder burns in your trousers you don't count for much. A form of intellectual chauvinism; and not surprising. Few know more in their particular field than the highly competent electronics serviceman.

But to ask for industry control is wrong. It confuses a quality with a measurable quantity, and asserts the existence of a need that exists only in the minds of those like Mr Banks.

Unlike him, I have never found a customer 'unwilling to pay a fair price for work done'. The emphasis here being upon 'fair'. I believe my notions of fairness might differ, however, from those of TETIA.

Licensing would neither rid this industry of incompetents nor save customers from the rip-offs that abound in it. The operation of the free market proves just as effective. Just as in Roman times when it was said 'a good wine needs no bush', if a person offers quality at a fair price neither remoteness nor inaccessibility will stop people from beating a path to his door.

Finally, I suggest Mr Banks' fears of 'being lumbered with some unworkable system by bureaucrats' are groundless. They are based on an unreal perception of the importance of the service industry, and the unjustifiable notion that the aims of politically motivated groups necessarily reflect the opinions, and indeed, the needs of the majority.

His fears should be laid to rest, along with the dead dog he and his cronies in

TETIA have been flogging since the late sixties.

As for the withdrawal of the 'Fault of the Month', much could be said regarding the psychology of groups and their need for secrets, but I will not bother here. I suggest it was of interest only to those in the trade anyway and, if the truth is known, of little real value. It's loss simply means you now have more space for something of greater general interest.

Thanks for your contribution to the debate, Mr Heywood Snr. I for one found your comments both interesting and thought provoking, and I'm sure others will too. Your point about the rapid changes in technology tending to make most of us equally 'unqualified', in time, is a very valid one — and one that applies to pretty well all of us in electronics, not just service technicians.

I also liked your point about a good service technician being very intelligent and creative, too. That's something I've always believed myself, and to me it explains why our Serviceman column has always been so popular — even with people who have very little technical knowledge themselves, and have no intention of ever trying to service equipment. Quite a few such people have told me, over the years, that they really enjoy reading Serviceman because often the stories are like 'who dunnit' mysteries; you keep reading to find out how the Serviceman finally tracked down the cause of the trouble!

There's also a ring of truth in Mr Heywood's suggestion that virtually everyone in the servicing industry, including Mr Ransley, will have gained some of their early experience through 'trial and error', and often at either the customer's or boss's expense. Trial and error surely forms an important part of the 'experience' that we all get, in just about any field of activity — a fact recognised in the old saying 'Show me someone who has never made a mistake, and I'll show you someone who has never done anything'. To suggest that 'qualified' technicians are somehow immune from this is indeed rather silly, as Mr Heywood Snr points out.

What *is* 'qualified'?

Anyway, let's move on to our next letter, which comes from Mr Bryan de Pree of Beaufort in Victoria. Mr de Pree takes up the matter of technical qualifications and their value, and gives it an interesting slant from his own experience:

I have enjoyed your magazine since 1969, but this is the first time I've put pen to paper to you, although I have contributed to Peter Phillips' articles.

The intense letter in 'Forum' 11/94 by a service technician regarding professional qualifications brought back some bitter-sweet memories. I am an electronics engineer, graduated in 1964 from the Polytechnic University in Arnhem, Holland. Despite assurances from the immigration officials, when I arrived in Australia in 1969 my qualifications were not recognised by the Australasian Society of Engineers. I was not even allowed to sit for an exam, to prove that I would be up to standard!

Some of the compulsory subjects in my secondary education (during all the five years) included: mathematics, physics, chemistry, biology, accountancy, French, German, and English; there were 16 in all. Although it is difficult to list subjects for a technical education, it included mathematics to the highest level, error theory, technical English and German as well. Both education levels require approximately 36 hours attendance per week; Saturday is a normal study day over there.

Honours graduate...

Although I graduated with honours and had worked as a development engineer at the Aeronautics and Space Laboratory in Amsterdam, and was a member of the first computer design team (all 16 of us) at Philips Computer Industries for three years before I entered this country, I was not given the opportunity to prove myself before this inward looking association.

After doing some development work on UHF transmitters for the then Commonwealth Development Laboratories, I got back into the computer field, this time as a service engineer. This was to me a completely different life, from being creative to fixing someone else's problems. Being overqualified, I progressed rather rapidly and was one of the country's highest paid computer engineers in 1971.

When I was state manager for an American computer company in 1983, I employed a man as an engineer who was 10 years my senior. This in itself would be politically incorrect nowadays, when age seems to be so important. But more is to come. He had no secondary or tertiary education and had run, as he called it, a 'lollyshop' for the past 18 years. The reason I took him on was that I found him to be a most intelligent and resourceful person. He had been the 'electric man' in a circus, and made shopping trolleys from junk collected on the tip in the depression years. He had his pilot licence and fixed the 'tug' of the glider club of which he was a member.

What was even more surprising was the fact that he had taught himself electronics (your magazine was partly to blame!), and designed the very first cell call system here. He did not have the money and time to patent the design, but nevertheless sold about 200 systems before the big brand items hit the market. Give him anything that has a transistor in it and with the schematic in hand, he'll fix it.

To cut a long story short; of the 10 engineers I employed with that company, all of them top people, he was by far the best overall. I doubt if he would be eligible to be a member of TETIA, even though he would beat most of their members hands down in technical skills. Now he is unemployed, as a result of a company demise, and being in his early 60's has little chance of obtaining a job. In the age where the emperor's magic coat seems to be discrimination, where is the Australian fair go for those with no piece of paper and no youth any more?

If we are going to be a smart country, does that not include taking stock of our talents other than looking at recognised and accredited education? To be honest, in my experience over the years in the electronics industry, I have found those that started out as amateurs in general to be better suitable for the job than others.

At the moment I have a running discussion with a 'properly trained' engineer who maintains that the different lengths of the positive and negative leads from a bank of batteries to an inverter effect the operation of the inverter in a major way. Sounds like the infamous speaker lead saga?

To be an academic and never having had dirty hands can lead one into fairy land. I sometimes wonder if we would be better off to send all the lecturers home and let the kids do their own education; perhaps we would end up with better professionals.

The attraction of magazines like 'Electronics Australia' is partly because people contribute who are electronic men down to their bones, with or without papers. It is good to have a magazine without the hype of many of the 'professional' magazines.

Thank you for your comments too, Mr de Pree, and again they're both interesting and thought provoking. You've certainly had not only personal experience of being 'tripped up' by lack of recognised qualifications, but also experience with a service engineer who excelled de-

spite lacking such qualifications. I guess quite a few of us have experienced either one or the other of these, but not both. Presumably you have even more reason than most to regard formal qualifications *per se* with a somewhat cynical eye...

At the very least, practical experience and old-fashioned enthusiasm need to be taken into account as well as qualifications, as you've pointed out. And I quite agree that often people who start off as 'amateurs' and keen enthusiasts can make far more capable 'professionals' than those who don't. We've certainly found that on the magazine itself, for example.

I doubt whether it's logical to conclude that we should close down all of our schools, TAFE colleges and universities, of course. Presumably you made this suggestion more in jest, as a way of emphasising the point. However I'm sure you're right in saying that if we really *do* want Australia to be a 'smart' country, we should be more flexible and place less emphasis on (blind faith in?) sheer formal qualifications.

Storm in a teacup?

Moving on again, our next contribution came in the form of a fax from Frank Russell, of Wendouree in Victoria (we've really got the Victorians going this time, haven't we?). Mr Russell is also picking up on the matter of TETIA's decision to discontinue 'Fault of the Month', etc., but his approach is a little different again, as you'll see:

I have just read with considerable amusement the series of letters in the 'Forum' column of the November issue, on the subject of TETIA's attitudes to service tech's qualifications.

My amusement comes not so much from the insular attitude of the correspondents concerned, but rather at the ridiculous storm in a teacup that has arisen over the discontinuation of the TETIA fault reports. The joke is that almost without exception, the faults that were published either related to very early models, of a type most unlikely to be presented in an average workshop for service at today's rates, and thus pretty much in the domain of the 'backyarder' anyway, and/or they were faults so routine and well known that few if any experienced technicians would not have been well aware of them!

As a matter of interest, my own formal training is in Electronic Engineering, with some 20 years of subsequent experience in both consumer and industrial diagnostic electronics maintenance. I am currently employed by the University at which I trained, as a senior Technical Officer (Electronics).

Ironically though, within the guidelines previously suggested by Mr Lawler, like you, I am unqualified! I have however, prospered in the industry at many levels, without ever needing to join TETIA or any other so-called industry body. If they like to keep a closed club, good on them.

Perhaps though, it's time for TETIA to join the real world, and realise that if they are truly to improve the image and standard of the industry, a much better approach than their apparent position of blind criticism is to invite the supposed 'cowboys' to join their ranks, where they can at least be evaluated by their peers, and be encouraged to train and develop 'acceptable' qualifications. I believe this would be more effective than throwing stones from a great distance, with poor aim and little real knowledge of the aptitude and talents of their objects of scorn.

My personal experience teaches me that TETIA still has a long way to go in cleaning up its own ranks, before they can afford to become overly critical of the performance of others.

Thanks for your comments too, Mr Russell. I imagine that your comments won't win you too many friends from within TETIA, but you're entitled to your opinions and some of the comments made on behalf of TETIA have been equally strong.

In fairness, I think it's a bit rough to suggest that all of the cases that were discussed in Fault of the Month concerned very early models of interest only to 'backyarders', or routine faults that would be well known to anyone with experience. Some of them may have been, but I believe quite a few of them would have been of interest to independent service techs and those in isolated areas, as well as some general readers trying to fix their own equipment.

I have to say that my own reaction to this whole business of TETIA dropping its support for Fault of the Month is more one of sorrow, rather than amusement. Not so much for the loss of 'FOTM' itself, but rather for what it seems to reveal about current attitudes in at least one area of electronics.

To me, one of the really good things about electronics in the past — as both a hobby and an industry — has been its spirit of cameraderie. Most of the people in electronics have been really involved in and enthusiastic about what they were doing, and were happy to share information and help each other increase their knowledge and skills — regardless of whether they were 'amateurs' or 'professionals', at one level or another. TETIA's decision to drop 'FOTM', and the reasons given for this decision, suggest to me that this spirit of friendly cooperation is now starting to wane — being replaced, it appears, with a somewhat more selfish 'Why should I share this knowledge with you?' attitude...

Perhaps this kind of change is inevitable, and simply another reflection of the way our society is becoming more competitive and aggressive. However I do find the change unfortunate.

I know previous Editors of *EA* took great pride in the magazine being a medium for allowing people at all levels in electronics to communicate with and help each other, and that's my continuing goal too. Many people have told me that's one of the reasons why they keep buying and reading the magazine, because despite all of the stresses associated with modern life, economic pressures and galloping technology, we still strive to foster this friendly spirit of mutual help and cooperation.

Call me old fashioned and naive, but the prospect of electronics becoming just another 'beggar thy neighbour before he beggars you' business doesn't give me much joy at all.

And with those few words, I think we might give this topic a rest — for a while at least. Don't you think? ❖

THE SERVICEMAN

The Sanyo colour TV set that I almost put an axe through!

This month my main story is from my own bench, and it concerns my long and incredibly frustrating battle with a Sanyo CTP6631 which seemed determined to send me either broke or insane. There's also a brief but intriguing story of a problem with noisy telephone lines, which turned out to have a surprising cause.

As I mentioned a couple of months ago, A.L. of Beverly Hills in NSW has given me a large collection of stories to chose from. I think the reward for such enthusiasm should be pride of place at the head of this month's column.

I don't know much about A.L.'s background, but from the subjects of his stories I would say that he was once a telephone engineer, now turned security system specialist. To show why I suspect this, we'll open this month with a yarn he calls 'The Slightly Pink Noise Problem'...

During the construction of a motorway, it was necessary to reroute a number of telephone circuits and as a temporary measure an open wire line was leased from the local railway authority. This line ran parallel to an electrified suburban rail service for about 10km.

We connected each end of this line to two 12-channel carrier terminal bays, to provide 24 bi-directional telephone channels. We aligned the system and early on a Sunday morning crosspatched the circuits affected by the motorway construction. These circuits all tested OK, but by midday on Monday we had received a number of complaints of random noise on these lines.

At the distant end the input of one of the noisy channels was terminated and a psophometer (a noise equivalent power meter) was connected to the near end of that channel. The incidence of the noise at first appeared to be quite random, but as the day progressed and we accumulated more data a definite pattern emerged.

The noise bursts occurred in groups of four or eight, over a period of 10 minutes, with a 20-minute pause when there was no noise. Suddenly the penny dropped! What we were recording was an analogy of the train schedules.

We obtained a timetable, from a staff member who travelled on that line and correlating the departure times for the upline and downline we found an excellent agreement.

To confirm this, we equipped a technician with a stop-watch and sent him on a train trip. The correlation of his results was perfect. The noise only appeared when the train was departing a station and the noise burst length corresponded to the period that the traction motors were series connected, as the train accelerated.

As this was only a temporary arrangement and there were no data circuits on the system, we decided to live with the problem until the permanent rerouting of the telephone circuits could be completed.

Well, how about that? I suppose it took a bit of lateral thinking to link the noise with local trains, but I imagine that those telephone circuits must have been pretty sensitive to be affected in that way.

I once had a workshop close by a Melbourne suburban railway line, and I can't recall ever noticing interference from the trains. However, that was in the days of five-valve mantel radios, and they weren't all that sensitive. Perhaps high gain audio circuits might have been different. Anyway, thanks A.L. for that story. We'll use more of your contributions in coming months.

Now, for a tale of woe from my own workshop.

Satanic Sanyo

Have you ever had one of those jobs where nothing seems to go right? You stagger from disaster to chaos and finish up hoping the workshop will burn down overnight! I've just completed one such job, and I can honestly say I have NEVER been so pleased to see a television set leave my premises.

In fact, I was so glad to see it go that I declined to charge anything for my labour — just the cost of the handful of parts needed to make the beast workable again. This is how it all happened...

It was a Sanyo 20" model CTP6631, fitted with an 80-P chassis and the complaint was that it just wouldn't work. There was no sound and no picture.

Initially, that was no trouble. The line output transistor, a 2SD869, was almost shorted. That sounds a bit odd, but it is a true description of the state of the transistor: it was showing about 100 ohms between each terminal. Usually, line transistors go dead short when they fail, or show 1000 ohms or so if they are just leaky. This one was halfway between the two states. I don't know what its condition signifies, but it means something as you will find later in this story.

There is no universal cause of line

output transistor failure, but one common cause is a bad drive waveform. This results in slow switching and excess dissipation, during the transition from 'on' to 'off' or vice versa.

Again, there is no usual cause for this trouble, but one thing I have found is a dried-out bypass capacitor on the supply side of the line driver transformer. This is often a low value, high voltage electro — and we all know what *that* means, don't we?

In this case the relevant cap is C451, a 4.7uF 160VW unit and I pulled it out for a close examination. It was showing no leakage, but its capacity had fallen to 4.0uF. This is within the specified tolerance of most electrolytics, but it is not normal to find one lower than its rating. Most are on the high side, so this one could have been on its way out.

I changed it for another capacitor, rated at 4.7uF but actually reading 5.7uF, which should eliminate any possibility of failure on that score for some time to come. I took the opportunity to check for dry joints around the driver and output stages, but could find nothing untoward.

It remained to be seen what would happen when I switched on, but this point in every job is a bit of a risk. No matter how carefully you check component integrity, there is always the chance that you've missed something and the job will blow up in your face — metaphorically speaking, that is.

This time, it was an anticlimax. Nothing unusual happened. The set came on with a good picture and normal sound, and as a final check, I measured the HT rail to see that there was nothing wrong in that department. So after a few hours of soak testing, I called the owner and invited him to take his set home. And that was where the story sat, for all of two weeks.

Then the customer was on the phone to tell me that the set had failed again, in apparently the same way as last time. Like most owners, when their set won't start up, he wondered if it might be the power switch and would it be worthwhile fitting a new one. I reassured him on that score, saying that I hoped it *was* the switch and that I would gladly fit a new one, but only if that really was the trouble. Unfortunately, it sounded to me like a repeat of the last fault.

Same problem!

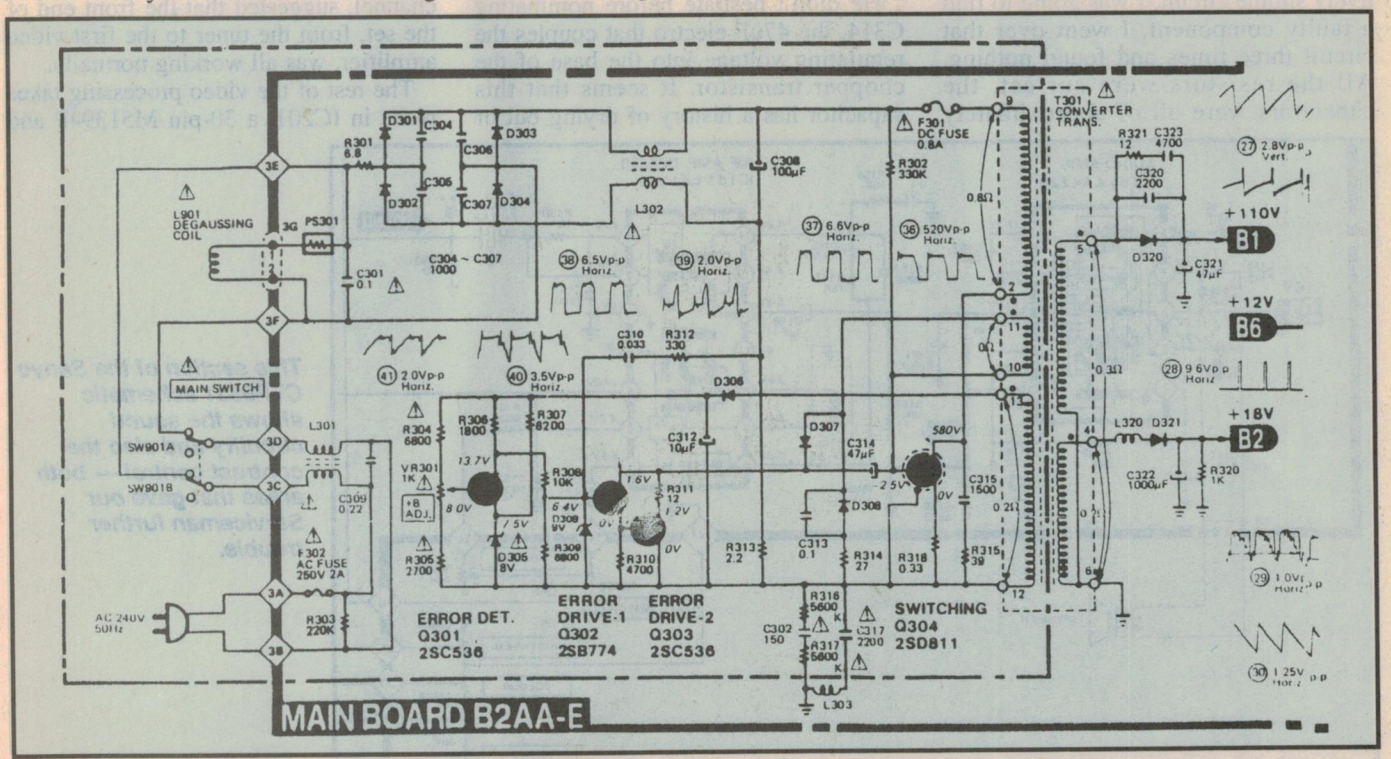
When he brought the set back, I found that it really was a re-run of the old programme. The new transistor was 'nearly' shorted, just as the last one had been. Now, if it had failed in any other way, I would have been happy to accept that I was facing a new problem. But this one was so nearly the same as last time that I began to get that sinking feeling. I sensed this was going to be a tough one, and I wasn't wrong!

I was still thinking along the lines of bad line drive, so after fitting a new output transistor, I left the collector open and gingerly switched on. This way, I was able to look at the line drive on the base of the transistor, to see if I could find any clues to the malfunction.

With the collector disconnected, the base waveform is not strictly correct but I've found it to be a good enough guide in these difficult circumstances. However I could find nothing wrong, so I had to reconnect the collector and try again. This time I attempted to protect the transistor by putting a 60W lamp in series with the collector. This limits the current that can flow in the transistor, in the event of a fault that might cause a short circuit.

Now the base waveform was perfect, as was the collector waveform — although the latter was much reduced in amplitude because of the load imposed by the lamp. I checked everything I could think of, including the B+ rail, and found nothing wrong. The only thing left to do was to remove the lamp and see what happened.

Well, what happened was this. As soon as I switched on, there was a loud squeal from somewhere inside the set, then nothing. And the new transistor was now half shorted, just like the others had been.



Some of our Serviceman's problems with the Sanyo CTP6631 originated in the switching power supply section, shown here. The regulation of the supply was intermittent, which had disastrous effects elsewhere in the set.

This was getting expensive! There was nothing for it but to replace the transistor, again, and refit the protection lamp. This time the nature of the fault, though not yet its cause, was quite obvious. The B+ rail was now reading 250V instead of 110V! No wonder the transistor died. But I wondered about the cause of death. Was it consistent — did the others die for the same reason? I still had to find out.

The power supply in this chassis is relatively simple. It comprises a self-oscillating chopper based on the converter transformer T301 and the chopper transistor Q304. As configured here, the chopper will deliver an output on the secondary side of the transformer at around 250 volts, as I had found to my disquiet.

The regulation circuit acts by reducing the chopper 'on' time by varying the voltage on capacitor C314. This voltage is developed across the Error Drive transistors Q302 and Q303, and is controlled by the Error Detector Q301. The only reference in the whole circuit is that provided by zener diode D305.

(The other zener, D306, appears to be an overload protector, since it is a 9V device but only ever has 6.4V on its cathode in normal service.)

So somewhere in this small and relatively simple circuit, I was going to find a faulty component. I went over that circuit three times and found nothing. All the resistors were correct, the capacitors were all of approximately correct value, the transistors showed normal gain and no leakage, and the diodes also showed no leakage. So what could be wrong?

To make matters even worse, when I next switched the set on, the power supply was delivering its correct voltage!

But you have to get lucky sometimes, and this time I got a little bit lucky. Even as I watched, the supply rail shot up to 250V again, which told me that I was now chasing a component that was intermittent. However, before I could hit the off button, a puff of smoke escaped from the audio output chip — which implied that my 'little bit lucky' patch was well and truly over...

In utter disgust, I pushed the set into a corner and went on with other work. I felt that a week away from the monster might let me attack it later in a better frame of mind.

Before I got back onto the job, I had reason to contact a colleague who has wider experience with Sanyo sets than I do. He is the local service agent for the brand, and has come across almost every problem that it can offer. After we had discussed the matter that had taken me to his workshop, I broached the subject of the runaway power supply in the 80-P chassis.

He didn't hesitate before nominating C314, the 47uF electro that couples the regulating voltage into the base of the chopper transistor. It seems that this capacitor has a history of drying out or going open, and this is known to cause elevated output from the power supply.

When I got back to my own workshop, I lost no time in removing the capacitor for a thorough check. I tested it for leakage and it got a perfect bill of health. But when I tested its capacity, it began by showing the correct 47uF, but then dropped suddenly to zero, and just as suddenly returned to correct value. So that was the trouble — an intermittent electro!

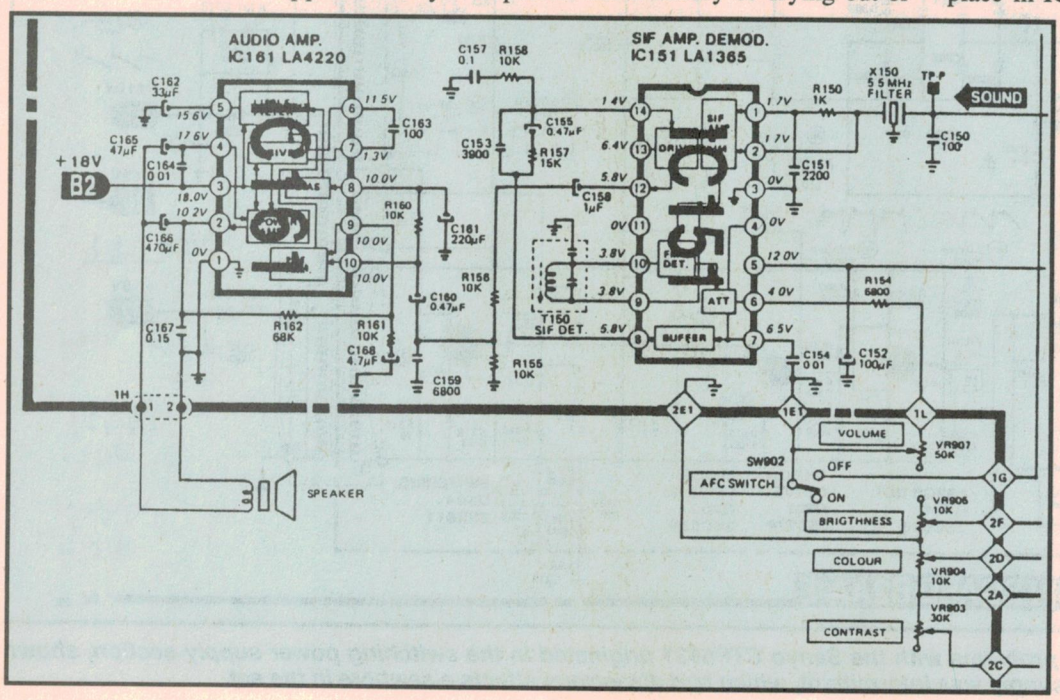
I replaced the capacitor and checked the output rail. It was a bit low, but responded to adjustment. And as far as I can tell, the power supply has performed perfectly ever since. However, that wasn't the end of the story; not by a long way.

No contrast?

As the tube warmed up, I could see a picture of sorts on the screen. There was lots of colour and the screen was bright enough, but the picture was very pale, as though the contrast was turned right down. When I turned the colour off, all that remained was a vague outline of the subject on a screen that was a little brighter than normal.

When I turned the set off channel, the screen filled with pale, weak snow. That, and the presence of colour on channel, suggested that the front end of the set, from the tuner to the first video amplifier, was all working normally.

The rest of the video processing takes place in IC201, a 30-pin M51394P and



This section of the Sanyo CTP6631 schematic shows the sound circuitry and also the contrast control — both areas that gave our Serviceman further trouble.

my CRO soon showed me that healthy video was entering that chip on pin 1. The first stage is a simple buffer, and I could see that it was working normally because of the good video emerging on pin 3. This video then goes two ways — to the chroma input on pin 29 and via the video delay line to the luminance input on pin 11.

However, I could find very little video on pin 11, or indeed anywhere along the chain of components around the delay line. The video amplitude dropped dramatically across R211, then changed very little up to pin 11. I couldn't make out exactly what was going on, but it did look suspiciously as though the video chip might have been damaged.

Next, I checked all of the voltages around the chip. They were all about 10% low, with the exception of pin 12 which should have been 6.2V but was in fact down to 4V. Now this pin is the input from the contrast control, which is a simple voltage divider from the 12V rail — although it does have a high impedance connection to the 110V rail. The low voltage made me feel that an investigation around this area might be in order.

Then I noticed the sub-contrast control (VR210) and I wondered what would happen if I adjusted this item. First, I made a note of the exact position it was set on, then I turned it first one way then the other. The first movement removed all traces of the picture, but the second improved the picture quite markedly.

This response suggested that I might have a contrast control problem, so I went to the front panel and tested the pot mounted under the tuner. It was supposed to be 30k ohms, but as far as I could tell it was around 300k. It was clearly worth a better look, so I removed the control panel and took the pot off the board.

Now the trouble was readily apparent, since the pot was open circuited from end to end, but OK from one end to the centre terminal. When I opened it up and looked at the track with a x10 magnifying glass, I could see where the 'hot' end of the track had been burned away from the terminal. This end was normally supplied with 12V from the 12V rail, which in turn is derived from the 15V rail. If the voltage had gone high enough to burn out the contrast control, one would think it should have done very nasty things to all the chips on the board. But that seems not to be the case...

I was able to effect a complete cure, without even having to change the contrast pot. I merely shifted the leads across one position, making the centre terminal the 12V input and the other end terminal the lead to the video chip input. (I don't often get that lucky!)

After I reset the sub-contrast control, the set delivered a first class picture, proving that nothing else in the picture chain was damaged. That only left the audio chip to be replaced, and that proved far less easy than it should have been.

The audio is processed in two chips, IC151 and IC161. The first, an LA1365 is the sound IF amplifier and demodulator. The second is an LA4220 audio drive and power amp. It was the latter chip that had 'lost its smoke'.

I had an LA4220 in my kit but it wasn't a new one. It had been taken from a working set that was junked because of a bad tube. I had no reason to think that the chip was faulty, but it was since after fitting it into the set, there was no sound and no voltages on any of the pins, except on pin 3, the 18V supply rail.

A close examination of the circuit showed that all the given voltages have to be derived from within the chip, since there are no connections to any other part of the circuit. This killed any hope that the fault might lie elsewhere on the board, and confirmed that my spare chip was faulty.

Finally, I used a small test amplifier to check that the input, on pin 10, was receiving a normal audio signal. Repairing the output stage would have been pointless if there was no audio to amplify. Fortunately, there was a normal signal coming from the demodulator chip, so the rest of the job looked as though it would be quite straightforward.

So it was back to my Sanyo Service Centre friend, to see if he could lend me an LA4220 until I could get a replacement. By this time I was desperate to finish the job and get the set out of my workshop. I didn't want to wait while I got a new chip from a distant supplier...

My friend's response to my request was a laconic "Ha! Ha!", and then "If you find any, get a dozen for me!" When pressed for an explanation, he told me that the chip had been discontinued some years ago, and was no longer available. There was a substitute listed, but it required a number of modifications to the circuit before it would work properly.

That news was the last thing I needed. I had already done more to this set than to just about any other I had ever worked on, and now I was going to have to rearrange the audio channel. If there'd been an axe handy, I might have used it to fix that set once and for all!

Sheet of mods...

Anyway, in due course the new chip arrived. It was an LA4265, and came complete with an instruction sheet detailing the procedures needed to complete the modification.

As I read through the instruction sheet, I began to think that this was more than just a modification. It was more like a total reconstruction!

First, C164, C165 and R162 are to be deleted. Then a 3.3-ohm resistor is to be added between C167 and ground, after cutting the track that links the capacitor to ground. Then R156 has to be changed from 10k to 56k, R160 from 10k to 3.3k, R161 from 10k to 270 ohms, C162 from 33uF to 100uF, C168 from 4.7uF to 100uF, C167 from 0.15 to 0.1 and C161 has to be shorted out. But that's not all...

The circuit track between pin 8 of IC161 and the positive side of C161 has to be cut, and a short circuit fitted between pins 8 and 10 of the IC. And of course, not to forget to change the IC itself!

After all this was finished, we once more had a fully functional television and I called the owner to come and take the accursed thing away. I had lost count of the time I had spent labouring over this set, and I couldn't have charged for more than a fraction of what it was worth. Instead, I billed the customer for the parts used and asked him to never, ever bring the thing back to me.

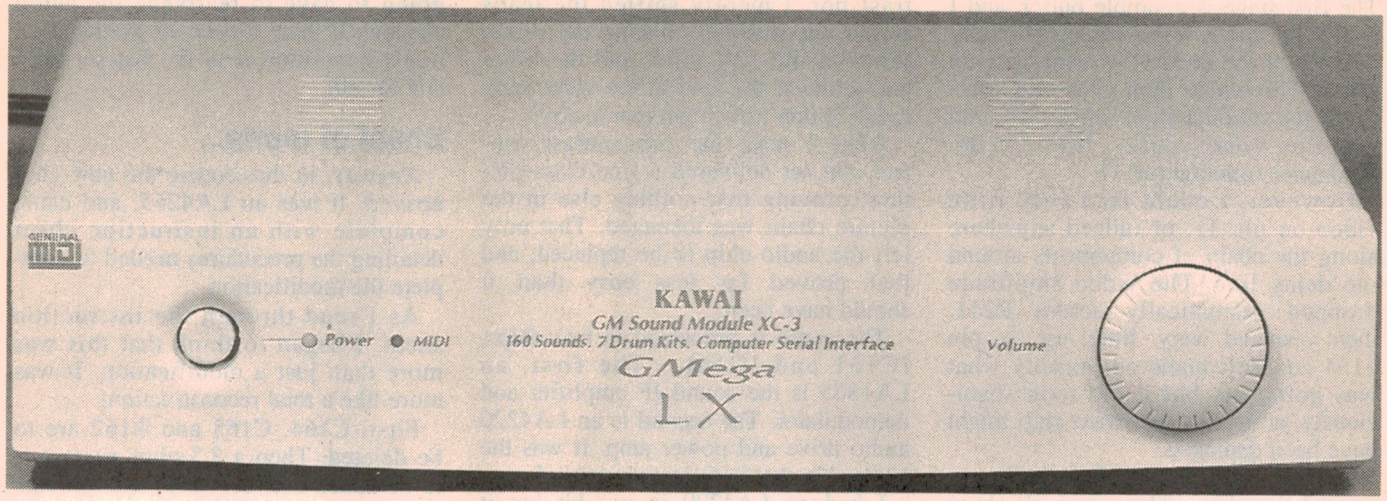
And to think that the whole sorry saga came about because of an intermittent open circuit in a 47uF electrolytic capacitor in the power supply!

Incidentally, before I leave this story, the mod sheet that came with the substitute audio amp chip listed all the Sanyo models affected by the changes.

There are no less than 123 model numbers in the list. Many of these are overseas models, but a majority could well turn up in this country. So whatever you do, when you are servicing one of these Sanyo sets, be very careful not to damage the LA4220 — replacing it will be a long and involved exercise!

That's all for this month. I'll have more interesting servicing stories for you next time. ❖

Kawai's external MIDI synthesisers take your PC



OUT BEYOND THE SOUND CARDS!

PC sound cards are fine for adding sound to games, and for your first experiments with MIDI music making. But for those who want to go further, 'outboard' synthesisers like Kawai's GMega and GMega LX provide an excellent way to boost your PC's MIDI synthesiser facilities with a minimum of hassle. The Kawai Datacat can also provide your PC with a compact, economical and very easy to use MIDI keyboard controller.

by JIM ROWE

Although many musicians have been using the MIDI (Musical Instrument Digital Interface) system for a long time, many of us have only become familiar with it in the last couple of years, with the welcome appearance of PC sound cards providing inbuilt MIDI interfaces, and also low-cost MIDI keyboards. And these new 'consumer level MIDI' products are great as far as they go, allowing you to get a good insight into the potential of a PC-based MIDI system for all kinds of experimenting with music.

But although just about any PC sound card gives you enough facilities for a good 'introduction' to computer-based music making, many of them turn out to be rather limited if you want to 'go further into it'. Most of them provide at least a basic MIDI interface and a digital audio recording and playback facility, but many of the cheaper cards have a fairly modest inbuilt music synthesiser. These may be fine for producing the sounds and music for games, but can prove very frustrating when you try any 'serious' experimenting — or even to produce music which sounds as if it's being played on recognisable instruments.

Fairly obviously, one solution is to replace your simple sound card with one of the more elaborate models, with a more powerful and flexible 'wavetable' type synthesiser. But this approach can have its own pitfalls; many of these fancier cards are considerably more complicated to install in your PC, occupying multiple I/O addresses and often requiring more than one of the PC's IRQ and DMA channels. In some cases, it can be very difficult if not impossible to get them going properly, without causing mysterious 'crashes' and other system malfunctions.

A simpler and in many ways more elegant approach is to keep your existing simple sound card, and use its MIDI interface as a 'doorway' out to a more powerful external MIDI synthesiser module. There's a growing range of these 'orchestras in a box', and quite a few of them not only provide more powerful facilities than all but the fanciest sound cards. They're also quite comparable in price.

With this approach you still have your original sound card's synthesiser available for games, etc., and you also avoid the complications of installing a more complex sound card. At the same time, you gain all of the benefits of a more powerful synthesiser...

Japan's Kawai Musical Instrument Company has been making high quality traditional acoustic musical instruments such as pianos for many years, and has also earned quite a reputation for its electronic instruments. Recently it expanded its range of MIDI-compatible products, first with the GMega synthesiser module and then with the GMega LX module and the Datacat keyboard controller. As these products are good examples of the kinds of 'outboard' MIDI units that can be used to expand a PC-based music system, we thought you might be interested to learn

more about them and of our experiences in trying them out with a typical computer system.

The GMega LX

Kawai's GMega LX, also known as the XC-3, is an enhanced General MIDI sound module which in many ways represents the 'next step up' from most PC sound card synthesisers. Although quite compact — it measures only 219 x 203 x 46mm, and weighs 0.9kg — it provides the same high quality 16-bit digital wavetable synthesiser 'engine' as Kawai's popular KC20 keyboard synthesiser, with a total of 160 different instrument sounds or 'voices', and seven different 'drum kits'. Of the 160 voices, the first 128 conform to the now standardised General MIDI (GM) specification, while the remaining 32 form a second bank of 'extras' and alternatives.

The GMega LX provides a full set of 16 General MIDI instrument channels, so you can program it to play up to 15 different instruments plus a drum/percussion kit, at the same time. It also provides 28-note polyphony — i.e., it can play up to 28 different notes at once, 20 on the instrument channels and the remaining eight on the drum channel.

A very worthwhile feature of the LX is built-in digital reverberation, which can be set up to simulate various kinds of acoustic environment by means of MIDI SysEx (system exclusive) commands. You have a choice of six different reverb types, plus control over reverb time, pre-delay time, and two selectable depth levels.

Of course there's also the ability to adjust overall pitch (+/-50 cents), the tuning of individual channel sections (+/-64 cents), transpose the key of individual sections (+/-24 semitones), adjust the level and stereo pan position for each channel, and so on. In short, the LX definitely qualifies as an 'enhanced GM' synthesiser rather than a 'basic GM' type.

A very interesting added feature is that along with the standard MIDI IN and OUT (THRU) ports, it also provides a 'computer type' serial port. This means that you don't even need a sound card or other MIDI port on your computer, to use it. You can drive it directly from a standard RS-232C serial port on an IBM-compatible PC, a Macintosh serial port, or the serial port on an NEC PC9800 machine.

The LX's extra serial port uses an eight-pin 'mini DIN' connector as used on the Apple Macintosh, with matching cables. It's on the rear of the case along with the standard 5-pin MIDI connectors, and alongside there's a slide switch which lets you select either the MIDI port (M) or the serial port as configured for either Apple Macs (A), IBM-compatibles (I) or NECs (N). Very flexible!

By the way, the LX also includes three inbuilt 'demo' tunes in ROM, for system testing and level checks, etc. It's powered from a 12V DC plug pack (supplied), and provides an audio output for stereo headphones as well as line-level stereo outputs.

The RRP of this very impressive enhanced MIDI synthesiser is $699. Available with it for an additional $100 is a matching software package with serial port MIDI drivers, an interactive music performance package called *Instant Pleasure*, and either of two MIDI sequencer programs: *Powertracks Pro* for IBM-compatible computers, or *GMS General MIDI Sequencer* for the Macintosh.

The GMega

Next step up from the GMega LX is the GMega synthesiser module, which was Kawai's first General MIDI unit. Although the names may be similar, the GMega synthesiser goes a lot further than its newer 'little brother' and is more suitable for those who want to venture more deeply into MIDI music making.

For a start, the GMega has no fewer than 256 inbuilt voices, organised in two separate tone banks: a 128-voice General MIDI bank and a second 'SP' bank of 128 further voices offering many different alternative instrument 'flavours' (and compatible with the Computer Music System). If that were not enough, it also provides a total of 256 different drum, percussion and sound effects sounds. In all, the digital information for this total of 512 stored voices takes up 48 megabits of internal ROM...

But the GMega isn't just a 'bigger orchestra in a box'. In addition, and unlike its little brother (and also most sound cards), it has full facilities for the user to create their own fully programmable voices. And these 'user programmed' voices can be stored in a third tone bank (this time in RAM rather than ROM), which has space for up to 128 instrument voices and a further 128 drum/percussion sounds.

The parameters for these user-programmable voices can all be edited via the GMega's seven front-panel controls and two-line backlit LCD screen. (They can also be edited on a computer

Kawai's GMega synthesiser module, which provides an impressive 256 in-built instrument voices plus the ability to program another 128 of your own. It offers 32 note polyphony and full General MIDI compatibility. Opposite: The GMega LX synthesiser module, which provides 160 instrument voices and seven drum kits.

Compact and attractively priced, the Datacat keyboard controller can generate control codes for any of the 128 notes in the MIDI pitch span, as well as many other control codes. It includes a dedicated 'pitch bend' controller wheel, and another wheel which may be assigned to a wide range of other parameters.

and downloaded into the GMega via SysEx commands, although more about this later.) There are over 30 programmable parameters per main instrument voice, controlling either the DCO (digitally controlled oscillator), DCF (digitally controlled filter) or DCA (digitally controlled amplifier) sections of each synthesiser channel. Similarly drum channel editing involves programming of some 23 different parameters.

The GMega uses Kawai's 'Digital Multi Spectrum II' synthesiser engine, which uses 18-bit DACs to replay the stored 16-bit waveform data. There are a total of 32 separate synthesiser channels, each of which can be programmed to receive on any of 32 MIDI channels — split between two separate MIDI input ports 'A' and 'B'.

So in effect, the GMega behaves like two separate 16-channel synthesisers in tandem, although they share its 32-note polyphony. Each of the 32 channels has its own programmable level and reverb depth, and the GMega also offers a choice of 55 different tuning temperament scales (Equal, Mersenne Pure, Pythagorean, etc.) — with the ability to program a different one into each of the 32 channels, if you wish(!). This gives the ability to produce 'thick' and complex orchestral textures, all from a single GMega.

Like the LX model, the GMega provides a standard serial data interface as well as the MIDI inputs and outputs. However in this case the serial port is only compatible with the Apple Macintosh, so owners of IBM compatibles will still need their sound card's MIDI port.

Needless to say the GMega offers all of the reverb options provided on the LX, as well.

Physically the GMega unit is almost the same size as its little brother, measuring 219 x 189 x 44mm and weighing only a little more — 1.5kg. It too runs from a plug-pack supply, which in this case is a 10V DC unit.

As you can see, the GMega unit offers considerably more than its smaller brother. Not surprisingly it's a little more expensive, with an RRP of $1199 — which still seems very reasonable, considering the large range of features it offers.

The Datacat

If you want to do anything more than simply use your PC-based music system to 'play' MIDI files like a high-tech canned orchestra, you need a musical input device or controller. For many people this will tend to be a keyboard.

While quite a few of the low-cost electronic keyboards are fitted with MIDI sockets and can be used for this purpose, they're generally not ideal. You can certainly get note on/off codes from them, and generally voice 'patch' programming codes as well, it may not be easy to use them for convenient input of other control information.

On the other hand, 'serious' MIDI keyboards can be rather expensive, and can represent overkill for someone who just wants to experiment with computer music. They're also pretty large!

There's a need, then, for a smaller version of the traditional MIDI keyboard controller — offering many of the same facilities, but in a smaller and hopefully cheaper package. And Kawai's new Datacat controller is designed to meet this very need.

The Datacat has a three-octave 37 note keyboard, a little smaller than standard but still quite easy to use. It also provides two controller wheels, one dedicated to pitch bending and the other able to be assigned to any of a wide range of MIDI programmable parameters (modulation, volume, pan-pot, damper pedal, etc). In addition there are four function select pushbuttons, used in conjunction with the top 11 keys for sending MIDI control codes as well as programming the second controller wheel, and another group of four transpose/octave select buttons. The latter allow the Datacat to transpose the keyed notes up or down by up to 12 semitones (each way), and also to shift the keyboard span either up or down by four octaves each way. In other words, it can cover the full 128-note MIDI span.

Measuring only 496 x 197 x 62mm and weighing 1.6kg, the Datacat is compact enough to fit onto most computer tables without undue embarrassment. It operates from either six AA cells, which fit inside the case, or from an external 9V DC plug pack. And it carries an RRP of only $299, which probably makes it about the cheapest way to provide your system with these facilities.

Trying them out

Kawai Australia very kindly loaned us demo samples of the GMega, GMega LX and Datacat units, so that we could try them out for ourselves. We used them with a 486/33MHz machine running *Windows 3.1*, and this allowed us to try out the *Powertracks Pro* sequencer software as well.

Since the test computer is fitted with a Sound Blaster 16 card, we were able to use the card's basic MIDI interface with our own MIDI Breakout Box project (February 1994) to provide the necessary full MIDI input and output ports. Similarly since the computer has a spare serial port, we were also able to try out the GMega LX's serial interface as well — after installing the appropriate Windows driver (supplied).

We tried out the GMega LX synthesiser first, and had no trouble at all driving it from either the MIDI or serial ports. We used it to play a wide variety of GM music files, and were frankly very impressed with both the clarity and realism of many of the instrument voices and the overall 'richness' of the sound when playing complex music. The piano voices were excellent, and with some pieces gave an uncanny reconstruction of an acoustic instrument being played. Bowed string voices seemed a little less successful, but this may have been the fault of the MIDI files we used...

Next we tried its big brother the GMega, and this again proved very easy to use as a straight 'GM orchestra in a box'. If anything its instrument voices seemed even more impressive than the LX model, and its piano voices again particularly convincing. Needless to say we also tried out many of the additional voices in the second SP tone bank, which give you a very wide selection of alternative 'instruments'.

We also tried programming our own voices using the GMega's front panel controls. There's a huge amount of flexibility here, with the potential to achieve almost any kind of 'instrument' you set your mind to — given enough time and patience. However we did find the programming system, using the GMega's front panel controls, a bit clumsy and tedious.

Frankly, our impression is that to realise the full potential of the GMega in this regard, you'd really need a 'patch editing' software program which would let you conveniently manipulate each of the parameters (preferably via an interactive graphical display), and then download the complete instrument voice 'patch' to the GMega to try it out. There are programs to let you do this sort of thing, but we haven't heard of one specifically suitable for the GMega.

Apart from this, though, there's no doubt that the GMega is a far more powerful and flexible synthesiser than its LX brother, and provides much more scope for the 'serious' computer musician.

While giving the sythesisers a reasonable workout we also had a good play with the Datacat keyboard, both as an input device for feeding tunes into a sequencer program, and connected directly to either (or both) synthesisers as a direct controller. And it too gave a good account of itself, proving a very convenient way to input not only tunes themselves, but also any of the various MIDI control codes we needed along the way.

In short, it seems a surprisingly convenient and practical little MIDI keyboard controller, despite its compact size and low price.

As part of our playing with the synthesisers and keyboard, we also gave the *Powertracks Pro* sequencer package a good workout. This seems quite a good Windows-based MIDI sequencer, with the ability to do most of things needed for fairly serious work on a PC-based music system.

About the only thing it seemed to lack is the ability to provide a 'pianola roll' representation of MIDI channel information. On the other hand, it can print out a MIDI channel in very presentable standard music notation, on virtually any Windows printer...

So if your sound card has whetted your appetite for MIDI music, but is now becoming a source of frustration because of its limited resources, these attractively priced MIDI products from Kawai are well worth considering.

There's only one problem: after you've heard your MIDI files played via the GMega LX or the full GMega, you'll never want to go back to your sound card's synthesiser! ❖

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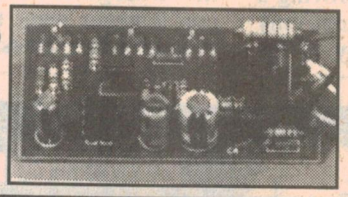

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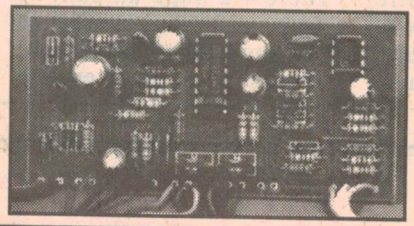
The affordable and fun way to build a very useful and highly versatile function generator! Both amplitude and frequency are voltage controlled so you can even combine two of these to make an audio sweep generator or amplitude modulated audio generator! Its voltage regulator ensures good stability against varying supply voltage and loading while a trimming facility is provided for frequency alignment when a calibrated dial is used. Can be powered from a single 9V battery (not supplied) or any DC supply between 8.5V and 15V. Comes in short form with all components, PCB & hardware such as pots and switches.

Cat K-2802 **$16.95**



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Get high quality stereo sound from your TV! You don't even need another stereo - this receiver simply hooks up to your existing hi-fi system. It provides for six preset tuning VHF or UHF channels and offers 'surround sound', subwoofer channel outputs plus, outputs for 'front centre' and 'rear ambience' as well as 'front left' and 'front right'. Supplied in full form with all components, hardware, PCB, case, pre-punched and screened front panel and tuner modules to suit.

Cat K-5990

NEW **$249**

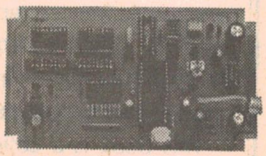
EA Jan '95

Versatile Solid State Audio Recorder

Great for reminder messages - to turn off your lights, put on your seatbelt or whatever you like! Record up to eight short messages or sounds and program them to replay in response to different trigger input signals. Its solid-state audio recorder IC allows you to re-record as many times as you like, with a total of 16 seconds recording time. Also features repeat selection and chime option. In short-form with PCB & all components including micro controller IC. All you need to do is build it.

Cat K-5019

EA Feb '95 NEW **$89.95**



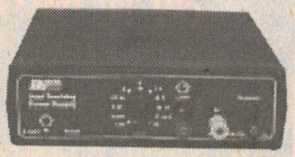
Great For Beginners!

Dual-Rail Power Supply

As this kit requires no mains wiring, it's the perfect starting kit for beginners. You can build your very own dual-rail power supply using an AC plug pack which already contains all the mains wiring. It provides 11 separate voltages from 1.25V to 15V and has a load switch and drop out LED. Comes complete with all components, PCB, hardware, case, front panel (punched & screened) and AC plug pack.

Cat K-3201

SILICON CHIP Oct '94 **$59.95**



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Talking Headlight Reminder

Can be used as a reminder alarm to alert you when your headlights are left on or for a number of other applications. Simply record your own reminder message (up to 16 sec.) and it will be continually replayed for 30 seconds. It's simple to build, using a single sound recorder IC and an external speaker. Comes in short form with components, PCB, and hardware items such as switches, mic. insert, speaker and record LED.

Cat K-5024

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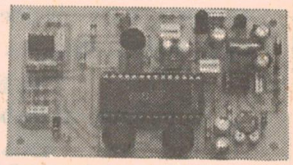

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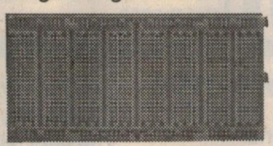

Ceramic Adjusters/Alignment Tool

You'll find these high quality adjusters perfect for computers, communication instruments, VCR, CD and other electronic devices. They're made from a combination of high-tech materials with zirconia ceramic blades and anti-static handles. Plus, they're non-conductive, non-magnetic, non-static and long-lasting. At just $9.95 each, you can afford to buy the complete set!

Cat T-5200 **0.9mm Flat**

Cat T-5206 **2mm Flat**

Cat T-5202 **1.3mm Flat**

Cat T-5208 **#0 Phillips**

Cat T-5204 **1.8mm Flat**

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Car Alarm With Battery Back-Up

This affordable kit places a quality feature-packed car alarm well within your reach. Based on the OM1681C Philips car alarm IC, it's straightforward to build yet it provides similar features to those found in expensive commercially available units. Such features include battery back up, presettable entry and exit delay periods, flashing status LED, automatic resetting after 60 seconds and the ability to automatically operate a central door locking system with optional interface controller (K-4314). Includes all components, PCB, hardware including automotive multiway connector, case & siren with back-up battery.

Cat K-4312

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SILICON CHIP Dec '94

Interface Controller To Suit

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Internally-slotted to accept PCBs, they're an ideal choice for any project that needs heat dissipation. Their black powder-coated finish gives an ultra-professional look to any project.

70(l) x 32(h) x 140mm(d)

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** Features sliding top panel (immobile when assembled).*

2 Channel UHF Remote Control

NEW

A very handy kit that provides you with remote control for two separate devices such as a car alarm or solenoid on boot latch. In a convenient keyring design, it features a button for each device and can operate in a range of up to approx. 20 metres with a 30cm antenna. Plus, it allows for 6561 security code options and is DC powered (between 10 & 15 volts). The receiver is a small module that uses surface mount components, is tuned to 304MHz and is supplied already aligned and tested. Kit will be supplied complete with all components, PCB receiver module, case, and one 2 channel transmitter (fully assembled).

Cat K-3260

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SILICON CHIP Jan '95

2 Channel UHF Transmitter

NEW

Additional transmitters to suit K-3260.

Cat K-3261

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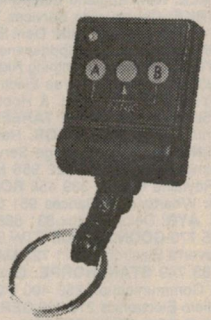

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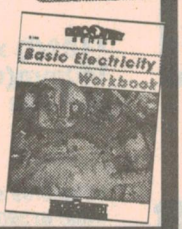

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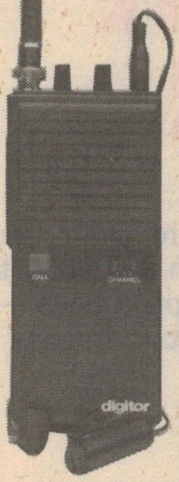

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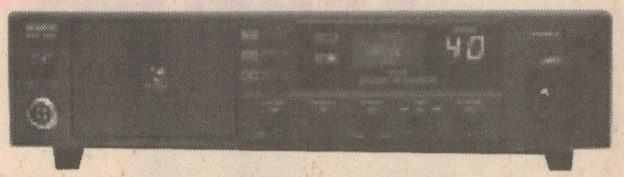

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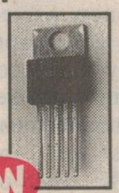

16-Second Voice/Sound Recorder Chip

ISD1461P

Cat Z-8000

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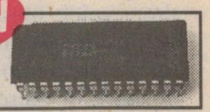

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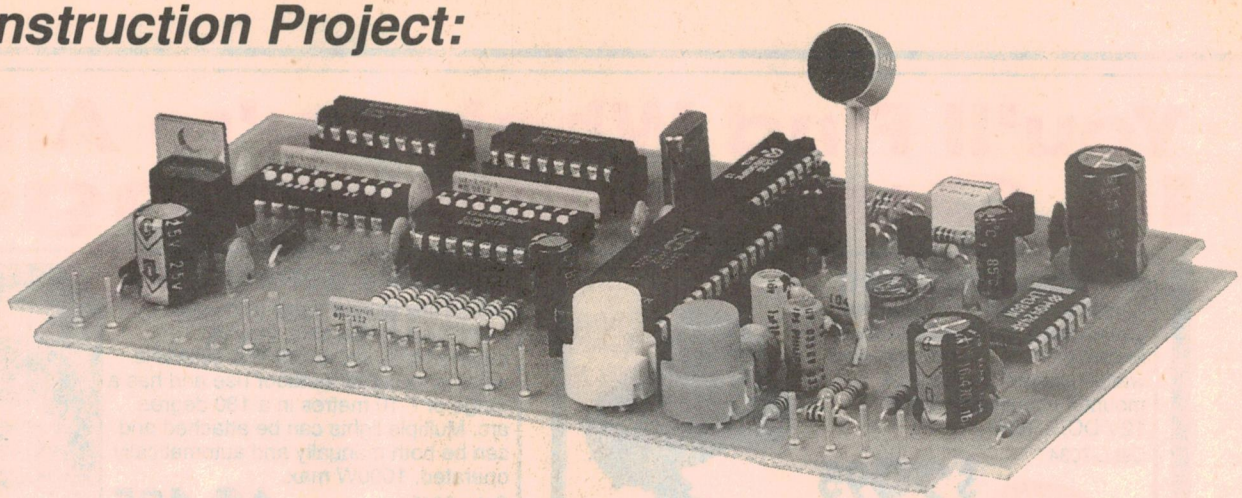


VERSATILE SOLID STATE AUDIO RECORDER

Microprocessor based, this project is a lot more than just a solid state audio recorder. You can record up to eight short audio clips, and then have it replay different clips in response to different trigger input signals. This gives it the potential for use in a wide variety of applications — from reminding you to use your seatbelt and turn off your headlights, to delivering your amateur radio callsign at regular intervals.

by BOB PARKER

'Versatile Multiple Announcement Circuit', or 'VMAC' for short, was about the most descriptive name I could dream up for this new project. It's an extremely flexible general-purpose circuit which allows you to record not just one, but up to eight different short voice messages, announcements, or maybe even sound effects, in a solid-state audio recorder IC. Then one or more of these recordings can be individually played back, by activating their corresponding 'trigger' inputs. It's up to you and your imagination to decide what external devices you'll connect to the inputs (and outputs)!

The recorder IC will retain your recordings, even with power disconnected, for about 100 years(!). However, you can re-record on the chip at any time, should you decide to change or update it. This can be done as many times as you like, but you do need power for the recording operation.

Using simple 'DIP' switch settings, any of the high impedance, voltage-protected trigger inputs can be easily individually configured to respond to either a 'high' or a 'low' voltage level, or a simple contact make or break.

Also programmable by DIP switches, any recorded segment can be set to play just once, or repeat endlessly, if its input stays triggered. So VMAC can tell you about a change in conditions, i.e., that a door you've fitted with a reed switch and magnet has opened or closed. Or it can keep repeating a warning about an abnormal condition, e.g., an engine oil pressure alarm.

In addition, the circuit can generate a pleasant, attention-getting 'chime' sound prior to each announcement, if desired. VMAC has a loud on-board 2W amplifier to drive an eight ohm speaker, plus a line level output of about 200mV RMS which could feed a public-address amplifier, amateur radio transmitter, etc.

Provision has also been made for mounting an optional relay, which operates during your announcements, on the board. This can be used to activate said PA amplifier or transmitter, or perform some other **low voltage** switching function you might have in mind.

The VMAC's power needs are reasonably flexible. It will operate from a DC supply of 10V to 20V and uses 25mA or so in its standby mode, but can draw several hundred milliamps when driving a speaker hard. For most mains-powered situations, a nominal 12V/300mA plugpack supply should be more than adequate. Of course it will also work well from a car's electrical system (but remember to put a 1A fuse in its supply lead!).

Many applications

Before giving you some examples of possible applications for VMAC, I have to state that Information Storage Devices Inc, the manufacturers of the audio recorder chip, reserve the right to exclude the use of their devices from the following: medical equipment, greeting cards and Christmas ornaments. If you think you might want to use a VMAC in any of those areas, please contact ISD's Australian agents, R&D Electronics, phone (03) 558-0444, for clarification of the situation.

Apart from the preceding, the uses for VMAC are many and varied. A large

area of potential application would be in industry, telecommunications and security monitoring, where it could supplement or replace existing visual and/or acoustic alarms and indicators.

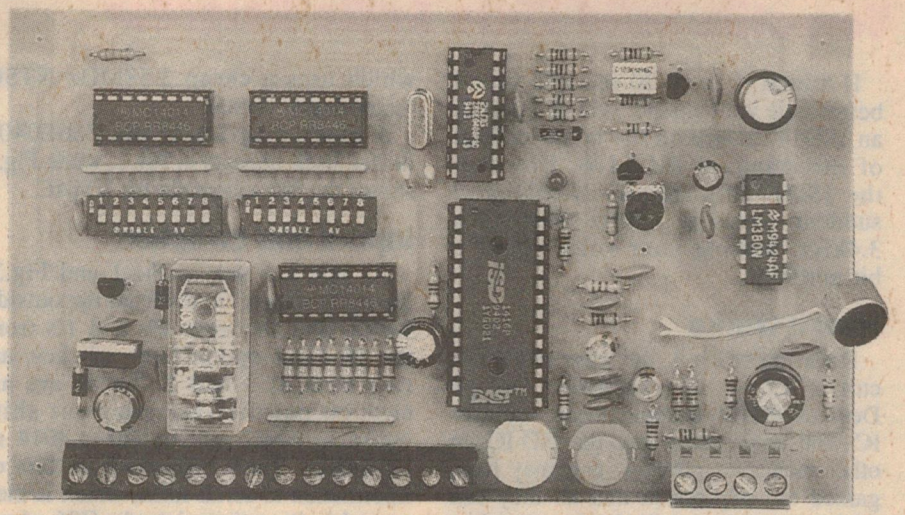
A voice indication of exactly what the problem is would be much more useful than simple alarm beepers. But there are lots of other possible uses, too. Radio 'hams' could record a couple of versions of a 'CQ' message and transmit them by pushing different buttons, or under control of a timer/sequencer — or use VMAC for repeater identification and status indications (instead of those robot-like speech synthesisers).

The VMAC could probably be of assistance to the visually-impaired, too. For example, a mate of mine suggested using one to help a blind person learn the controls for operating a mobile radio base station, while another has drawn attention to possible sight-impaired and multilingual uses in the tourism, accommodation and travel industries.

In your house you could connect each of several doorbell buttons to its own trigger input, and record an appropriate announcement for each one. Or install the circuit in your car and use it as an audible addition to the warning lights, plus a 'lights on' reminder, etc.

Model railway enthusiasts could possibly 'dub' steam train sounds, etc., from tape recordings, and connect a VMAC to their layout — using the trains to trigger it via reed switches, opto sensors and so on.

So if you can think of uses for VMAC, keep reading! In a forthcoming article I hope to be bringing you some details of applications we've already thought up...



A top view of the 'ruggedised' version of the VMAC, with PCB mounting terminal strips fitted to the board instead of PCB pins for the off-board connections. This board has also been fitted with the relay and its driver transistor.

Recording time

Each of your announcements can be of any length you like, as long as they all add up to a **total** of no more than 16 seconds. This mightn't sound like much time, but make a list of announcements you might like to have, using a sensible number of words for each one (e.g., "There's someone at the front door!" or "Oil pressure warning!"), and use your faithful digital watch to measure how long it takes to say them all.

You'll probably be surprised, as I was, to find that you can fit a lot of words into 16 seconds if you're slightly careful. And naturally, the fewer announcements you need, the more time you have available for each of them!

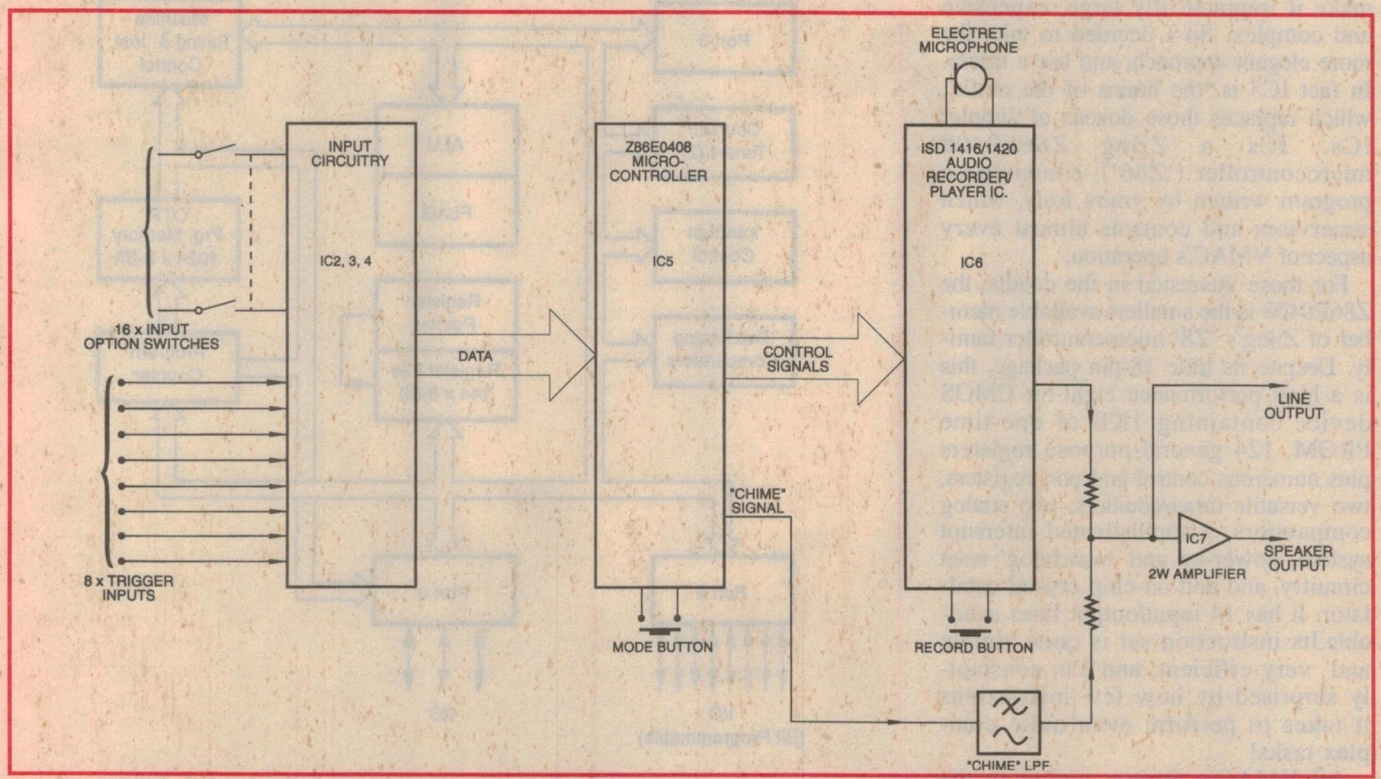


Fig.1: A block diagram showing the overall configuration of the VMAC unit. The input circuitry provides a very flexible triggering system, so that the micro can replay any selected audio clip from the recorder chip IC6.

If a total time of 20 seconds would better suit your needs, you can install an ISD1420 chip on the board instead of the standard ISD1416. However the ISD1420's frequency response suddenly stops at 2.7kHz rather than 3.4kHz, making your voice sound a bit muffled...

How it works

Referring to Fig.1, the heart of the circuit is IC6 — an Information Storage Devices ISD1416 audio recorder/player IC. You've probably seen the ISD ICs in other magazine projects, and may have gained the impression that all they can do is record just a single message then play it back again, with the possible options of pausing and repeating.

In fact these extremely sophisticated devices have also been designed to selectively record, play and 'fast-forward' through multiple messages. All you need is the appropriate external control logic circuitry, to take advantage of these features. (Sounds easy enough, doesn't it? Needless to say, it took quite a bit of work...)

Now if you were to design this circuit around ordinary small or medium scale integrated chips, it would probably take two dozen or more of them to implement all the functions of VMAC, which would make it impractically large, expensive and complex. So I decided to take the more elegant approach, and use a micro. In fact IC5 is 'the brains of the outfit', which replaces those dozens of simpler ICs. It's a Zilog Z86E0408 microcontroller ('Z86'), containing a program written by yours truly, which supervises and controls almost every aspect of VMAC's operation.

For those interested in the details, the Z86E0408 is the smallest available member of Zilog's 'Z8' microcontroller family. Despite its little 18-pin package, this is a high performance eight-bit CMOS device containing 1KB of one-time PROM, 124 general-purpose registers plus numerous control and port registers, two versatile timer/counters, two analog comparators, a sophisticated interrupt system, power-on and 'watchdog' reset circuitry, and and on-chip crystal oscillator. It has 14 input/output lines available.Its instruction set is quite simple and very efficient, and I'm constantly surprised by how few instructions it takes to perform even quite complex tasks!

All VMAC's timing, including the chime frequency and duration, is derived from the micro's master clock oscillator, which uses a cheap 3.58MHz NTSC 'colourburst' crystal.

A block diagram of the Z86E0408 device itself appears in Fig.2, while Fig.3 shows the full schematic for VMAC.

Inputs and switches

As you can see in Fig.1 and Fig.3, the eight trigger inputs from the outside world, plus the logic 0's and 1's from the 16 input option DIP switches, arrive at IC4, 3 and 2. These are all eight-bit parallel-in/serial-out shift registers, which can be either 4014 or 4021 chips. These convert all 24 'bits' of information to serial form, which is then moved in its entirety into the Z86, about 100 times per second. This method of inputting the data has been made necessary by the fact that we need to look at a total of 24 bits, while the Z86 has only 14 input/output pins — and many of them are used for other purposes anyway!

Inside the Z86, the data is subjected to timing and logical operations which, after 'de-bouncing' the inputs, eventually form a 'list' of any messages which need to be played, based on the input conditions and DIP switch settings. If any input trigger condition of more than 30ms duration occurs at any time, the Z86 will 'grab' it and add it to its 'playlist'.

Playback sequence

When triggered, the Z86 'fast forwards' IC6 through its memory from the first to the last recorded segment in sequence, dropping to normal speed and playing any segments which are on its 'list'. If lower-numbered segments are triggered while a high-numbered segment is playing, it 'loops around' and starts the process again from segment one. A side-effect of this process is that under rapidly-changing input conditions, messages mightn't be played back in exactly the order they were triggered in — so please keep this in mind!

As you can see in the photos, there are two 8-way 'DIP' switch packages on the board. On each, counting from left to right, the individual switches number 1 to 8, corresponding to trigger inputs and recorded segments 1 to 8.

The right-hand switches (SW2 A-H) are the 'polarity' ones, and they determine what input voltage level will trigger

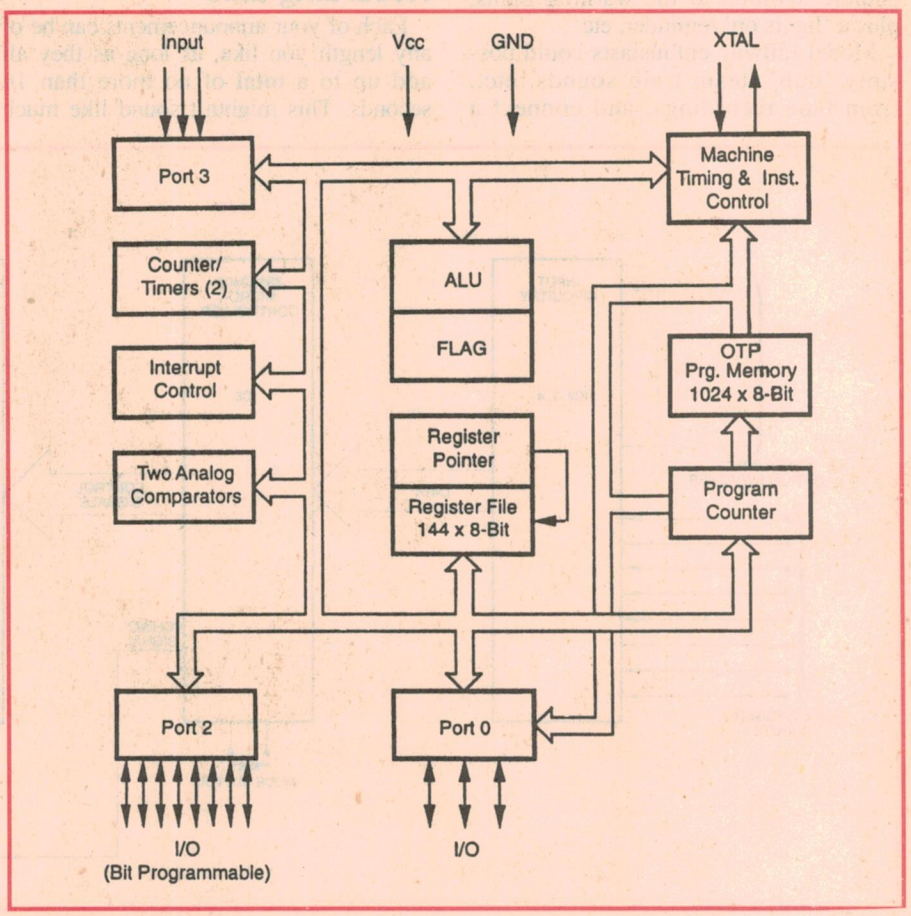


Fig.2: The internal architecture of Zilog's Z86E0408 microcontroller chip, which is used as the 'brains' of this project.

a given switch's corresponding recorded segment. If the switch is open ('OFF'), that input will trigger when its voltage *drops* to a low logic level (0V - +2V). Conversely a closed or 'ON' switch will cause an input to trigger when its voltage *rises* to a high logic level (+3V - +20V).

Because of pullup resistor pack RP3, all unconnected inputs are already automatically sitting at +5V — a 'high' level. So the polarity switch for each *unused* input should be left **open** ('OFF'). More about connecting the inputs to external devices, later...

Repeat selection

The left-hand DIP switches (SW1 A-H) are the 'repeat' option ones. If a switch is open ('OFF'), it means that when its corresponding input changes from its normal to its triggered state, the VMAC will play back the recorded segment belonging to it, **once**. Then the Z86 will ignore that input until it has first returned to its normal condition, and again gone to its triggered state.

For example, say Input 1 was connected to your car's rear window demister, SW2A was closed (to trigger on a HIGH voltage level), and SW1A was OPEN (for non-repeat). Then when you turn the demister on, the VMAC would say "Rear demister on!" (or whatever) just once, despite the ongoing trigger condition.

If a repeat option switch is *closed* ('ON'), the VMAC will continue (irritatingly!) to repeat the segment associated with that input, for as long as that input remains triggered.

Chime option

In contrast with the preceding, the chime option is absolutely straightforward! If you want VMAC to generate a chime prior to each message, simply park the 'jumper' between the centre and left-hand side pins. For no chime, place it between the centre and right-hand side pins.

Recording mode

Now you know how VMAC plays back your announcements, messages or whatever, let's discuss how to record them in the first place!

In the photos you'll have noticed two control buttons; the one on the left is the MODE button, and the other is the RECORD one. The recording process begins with you making a list of your announcements, starting from segment number 1 up to the maximum segment number 8, in numerical sequence.

When you're ready, and with the VMAC currently **not** playing anything, press and continuously hold down the MODE button for the duration of the recording session. Then, pressing the RECORD button as well, speak your first message (segment 1) in a normal voice, about 150mm from the microphone. The LED will light to indicate that recording is taking place.

Immediately you finish speaking, release the RECORD button — but keep holding down the MODE button. Then continue this process with segment 2, etc, until all your announcements are safely stored in the chip. The MODE button must remain pressed for the whole recording session, but the RECORD button is pressed only during the recording of each segment.

If the LED goes off while you're recording, it indicates you've used up all of IC6's storage space. Next time you're

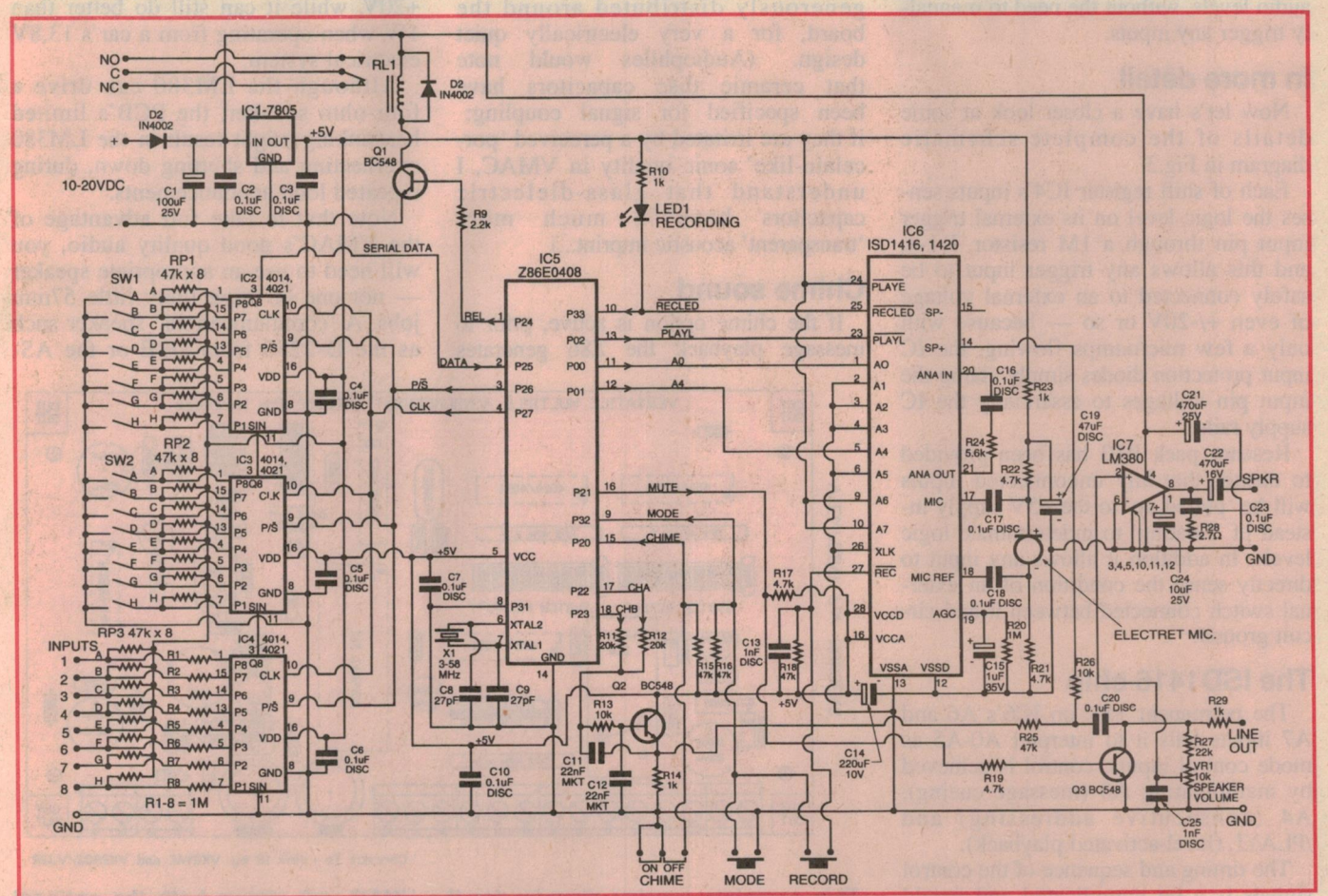


Fig.3: Here's the full schematic for VMAC. It may look a little complex, but the hardware operation is fairly straightforward thanks to the 'intelligence' of the author's firmware — programmed into the microcontroller IC5.

going to have to either speak faster, use less words, install an ISD1420 chip — or build a second VMAC board and make the kit suppliers happy!

When you release the MODE button, the VMAC will play back the entire contents of IC6 — or the first eight recorded segments, whichever comes first. A chime sound will precede each segment if that function is enabled, and the relay, if installed, will operate for the duration.

If you 'fluffed your lines' and want to cancel playback prior to another recording effort, hold the MODE button down until the end of the segment currently playing, then release it. This will return the system to its 'idle' mode.

A minor problem with the way the ISD1416 chip works in this application is that you can't re-record just one message and leave all the others as they are. You must record all of your messages again, if you make a mistake or want to add new ones. Any time the VMAC is idle, you can simply press the MODE button briefly without recording, to play everything back. This is handy for setting up audio levels, without the need to manually trigger any inputs.

In more detail

Now let's have a closer look at some details of the complete schematic diagram in Fig.3.

Each of shift register IC4's inputs senses the logic level on its external trigger input pin through a 1M resistor, R1-8, and this allows any trigger input to be safely connected to an external voltage of even +/-20V or so — because with only a few microamps flowing, the IC input protection diodes simply clamp the input pin voltages to essentially the IC supply rails.

Resistor pack RP3 has been provided to ensure that any unconnected inputs will be 'pulled up' to the +5V supply instead of 'floating' to indeterminate logic levels. In addition it allows any input to directly sense the condition of an external switch connected between it and circuit ground.

The ISD1416 chip

The permanent +5V on IC6's A6 and A7 inputs tells it to interpret A0-A5 as mode control inputs; control is achieved by manipulating A0 (message cueing), A4 (consecutive addressing) and /PLAYL (level-activated playback).

The timing and sequence of the control signals is a bit complicated and would take up too much space to explain here, so if you really want to know how to drive an ISD1416 in this way, please contact R&D Electronics for the ISD data books. A low level on /REC immediately places IC6 in the record mode, and it's worth noting that C13's function is to 'swamp' stray capacitance which could otherwise cause a momentary (disastrous) unwanted recording when power is first applied.

Going in the other direction, the /RECLED signal, which drives the 'recording' LED, also tells the Z86 when playback of a segment has concluded. That's why the LED blinks at the end of each segment during playback.

On the analog side, the electret microphone is connected differentially to IC6's automatic gain control (AGC) stage inputs, giving excellent rejection of electrical noise; R23 and C19 provide bypassing of any noise on the microphone's +5V supply. C15 and R20 provide the AGC time constants, while C16 and R24 couple the AGC stage output signal, at an appropriate level, into the chip's main recording input at pin 20.

Supply bypass capacitors are generously distributed around the board, for a very electrically quiet design. (Audiophiles would note that ceramic disc capacitors have been specified for signal coupling; if they are irritated by a perceived 'porcelain-like' sonic quality in VMAC, I understand that glass-dielectric capacitors have a much more 'transparent' acoustic imprint...)

Chime sound

If the chime option is active, prior to message playback the Z86 generates and feeds a 'chime-shaped square wave' into the chime low-pass filter — consisting of R11, R12, R13 and R14, C11 and C12, plus Q2. Its output, an approximate sine wave of decaying amplitude, is mixed with IC6's output via R25 which matches the chime level to the voice level.

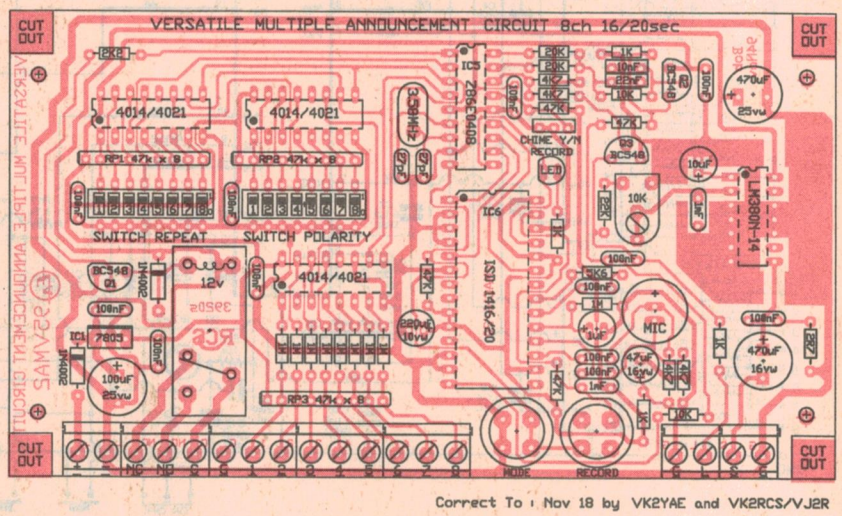
Q3's function is to effectively short-circuit the audio output, under control of the Z86, except when a chime signal is being generated or IC6 is actually producing an output. Otherwise IC6's 'SP+' pin, alternating between 0V and +2.5V, causes very loud clicks to reach the output.

Q3's configuration might seem a bit strange, but this method of audio muting is quite common in hifi equipment such as tuners and compact disc players, and works very well. R29 protects Q3 from damage if the line output is accidentally connected to an external voltage or the speaker output.

For maximum versatility, VMAC uses an LM380 power amplifier chip. This can drive an eight-ohm speaker to more than 2W at a supply voltage of +20V, while it can still do better than 1W when operating from a car's 13.8V electrical system.

Although the LM380 can drive a four-ohm speaker, the PCB's limited heatsinking might result in the LM380 overheating and shutting down, during repeated loud announcements.

Note that to take full advantage of the VMAC's good quality audio, you will need to use an appropriate speaker — not one of those tinny little 57mm jobs. A 'communications' speaker such as the D-2250 from DSE or the AS-



This complete overlay diagram for the VMAC unit shows both the optional terminal strips and relay circuitry. As explained in the text, these need not be fitted if you wish to leave them out.

3185 from Jaycar will give good results. C23 and R28 keep the LM380 electrically stable into any kind of reasonable speaker load, and C25 bypasses any stray RF signals which may be lurking about.

Hardware options

Because of VMAC's wide range of possible applications, there are several options available to you in its construction and installation. By sawing off the PCB corners where marked, the PCB will fit snugly into a common plastic 'UB1' size (150 x 90 x 50mm) utility box such as Jaycar's HB-6011 or the H-2851 from DSE.

If you want to be able to change your messages and adjust the speaker volume without removing the box's lid, install normally-open panel-mount pushbuttons (preferably the sort that don't click), an LED mounting sleeve, a 10mm inside diameter grommet (Jaycar HP-0704 etc) for the electret mic and a 10k pot, all on the lid itself.

Then use long wires to extend the button and LED connections to the PCB, and a length of thin screened wire (shield to the negative terminal) to the microphone, which you push into the grommet. Use two more lengths of screened wire (shields to the ground pin) to connect the pot to where VR1 normally lives. The use of PCB pins will make this procedure considerably easier...

As previously mentioned, you can install a 12V SPDT relay on the PCB to control an external circuit. Examples are the Jaycar SY-4050 and DSE's P-8010 — but DO NOT attempt to switch 240V with it! The PCB is **not** designed or laid out for mains voltages, and in any case mains-borne electrical noise could hang up (or blow up!) the Z86.

By all means control an external 240V-rated and appropriately wired relay with it, if you need to control a 240V load.

The last option is that PCB-mount screw terminal blocks can be fitted to the board if you wish, instead of ordinary PCB pins, for connecting to the 'outside world'. The PCB has been designed to directly accept them, but you'll probably need to enlarge the holes a bit first.

Construction

Before installing any components on the board, hold it up to a bright light and check for any bridges between conductors, or any fine track breaks. If you're going to be installing the board in one of the previously-described boxes, *now* is the time to carefully cut off the corner areas so it clears the box's lid- mounting 'pillars'. It's also the time to use the blank PCB as a template for the box mounting holes.

Next begin mounting the components. I suggest the use of a temperature-controlled soldering iron running at about 360°C, and if the kit supplier has provided thick solder which would be more suited to building a valve amplifier, please replace it with something more appropriate such as N-1636 in the DSE catalog!

First solder in the resistors and diodes. Then you can install the 'taller' parts, taking the usual care to get the orientation of the polarised devices correct. This includes the electrolytic capacitors, diodes, ICs and sockets, LED, and transistors. The 'common' pin 1 on resistor packs RP1, 2 and 3 is identified by a dot, and this goes at the end furthest from IC5 and IC6.

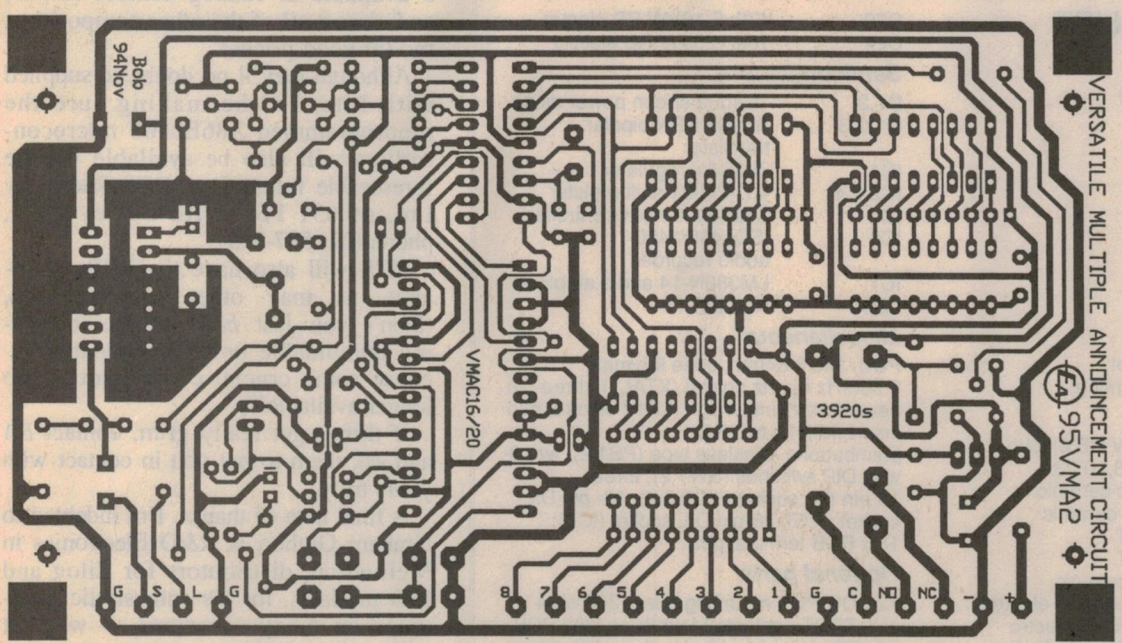
The electret microphone should be mounted on thin flexible wires about 30 to 50mm long — otherwise it picks up loud 'clack' vibrations from the RECORD button. The negative terminal is the one connected to its case; install this last. At this stage it's probably a good idea to place the chime-select 'jumper' on its centre and left-hand header pins, before you lose it!

Apart from IC1 and IC7, leave all the ICs in their antistatic packaging until you've completed the initial checks. I recommend you use IC sockets for all the DIP ones except IC7 — this needs to be soldered directly to the board to allow efficient heat transfer to the large copper area beneath it.

With everything but the socketed ICs on the board, hold it up to your bright light again and check very carefully that there are no solder bridges, especially where tracks run between IC pins. There are a few areas where a solder bridge would be catastrophic! Then double check that all components are properly soldered in their correct places and the right way around.

Testing it

Before installing any of the socketed ICs, connect the power supply pins to a source of 12V or so and see that the cur-



5.7" x 3.3" (145mm x 84mm) 343 HOLES

And finally, here's the PCB pattern reproduced actual size for the benefit of those who like to etch their own boards.

rent drawn is less than 30mA. If it's more, check again for misplaced or disoriented components.

Next check the IC sockets, and see that you're getting +5V on: pin 16 of IC2, 3 and 4; pin 5 of IC5; and pins 9, 10, 16, 24 and 28 of IC6. You should see about half your supply voltage on pin 8 of IC7, and if not, start checking for problems in that area.

If everything's OK to here, disconnect the power. Then, (this is important) after discharging any static electricity by touching some nearby earthed object such as your power supply case, unpack and install the socketed ICs — making very sure that they're the right way around.

Now set all the DIP switches to their OPEN ('OFF') positions, connect a speaker between the 'S' and adjacent 'G' pins, and turn VR1 about 30% of the way around from full anticlockwise.

Reconnect the power and you should hear two chime sounds from the speaker, indicating that the Z86 is operating. If you've installed a relay, it should operate during the chimes then immediately release again. At this point you can record and play back some test messages, as described earlier in 'Recording Your Announcements'.

Connect a clip lead or similar to the power supply negative terminal, and you should be able to trigger any of your messages separately by grounding their input pins. If all's well, now you can record some real messages and familiarise yourself with the overall operation of your new 'VMAC'. As mentioned earlier, in a later article I hope to bring you some ideas and simple circuits for interfacing it with 'the real world'.

If it malfunctions

I truly hope you don't need to read this, because fault-finding a project like VMAC is not terribly easy!

First I have to stress that the chances of a brand-new component being faulty are very low. Assuming all the components are where they belong, the PCB has no apparent defects, and the +5V supply is appearing everywhere it should be, you could check the following: If single recordings are getting broken into multiple segments, and other strange things are happening, check that neither of the buttons is intermittent when pushed; this happened on one of the prototypes...

Are all socketed IC pins correctly seated? Have you omitted to solder any joints?

Are any of the ICs getting hot (apart from IC1 and 7 getting slightly warm)? If yes, remove the power and recheck the soldering around it very thoroughly! If you do find a short, you might have to replace the IC anyway...

If the Z86 is operating normally, at switch-on its pin 1 will pulse to +5V for about a second, then drop to 0V again. If it doesn't, is the crystal OK? (They just *hate* being dropped!) The Z86 is very unlikely to be faulty, unless it got zapped by static electricity when you were installing it.

If IC6 records, indicated by the LED illuminating, but there's no playback, check the electret microphone's polarity.

If there's +2.5V and an audio signal on IC6 pin 14 but it doesn't reach the outputs, is there a problem with mute transistor Q3? Its base voltage should go to 0V during playback. Did you connect your speaker to the right pins?

If you touch the wiper connection of VR1 at mid-adjustment, you should hear a slight buzz from the speaker. Check IC7 if you don't.

A loss of chime, with a 'gap' in playback where it should have been, suggests a problem around Q2 — is its emitter voltage about +2V?

If the VMAC isn't responding correctly or at all to its inputs and DIP switches, check for a 9.5ms high/500us low waveform on pin 9 of IC2, 3 and 4. With the DIP switches set randomly, there should be 100Hz bursts of high-frequency activity on pin 10 of those ICs, as well as on IC2 pin 3.

A loud 'machine-gun' sound between playback messages means the muting transistor Q3 isn't functioning: check its orientation and R19.

Unusual parts

If you're not building the VMAC from a kit and you're looking for some of the less common parts, Rockby Electronics of PO Box 189 Huntingdale 3166, phone (03) 562-8559, have the 47k resistor packs RP1, 2 and 3 available as catalog number R5905, and almost all of the other components, too (at good prices).

Although they'll no doubt be supplied with kits, I'll be making sure the preprogrammed Z86E0408 microcontrollers will also be available for the foreseeable future from RCS Radio Pty Ltd, of 651 Forest Rd Bexley 2207, phone (02) 587-3491.

RCS will also have the PCBs available, as may other suppliers too. (Don't you just *hate* projects becoming unbuildable or unmaintainable because some crucial component is 'no longer available'?)

If things get really grim, contact *EA* and ask them to put you in contact with yours truly.

A final note of thanks. I'm indebted to Graham Giulieri at R&D Electronics in Melbourne, distributors for Zilog and ISD products, for his enthusiastic assistance on many occasions — without which the VMAC would not exist. Thanks, Graham! ❖

PARTS LIST

Resistors

(All 0.25W unless noted)

R1,2,3,4,5,6,7,8,20	1M
R9	2.2k
R10,14,23,29	1k
R11,12	20k
R13,26	10k
R15,16,18,25	47k
R17,19,21,22	4.7k
R24	5.6k
R27	22k
R28	2.7k
VR1	10k trimpot, horiz mounting

Capacitors

C1	100uF 25V RB electro
C2,3,4,5,6,7,10,16,17,18,20,23	0.1uF disc ceramic
C8,9	27pF disc ceramic
C11	22nF MKT
C12	10nF MKT
C13,25	1nF disc ceramic
C14	220uF 10VW RB electro
C15	1uF 50VW RB electro
C19	47uF 10VW RB electro
C21	470uF 25VW RB electro
C22	470uF 16VW RB electro
C24	10uF 25VW RB electro

Semiconductors

D1,2	1N4002 silicon power diode
Q1,2,3	BC548 NPN bipolar transistor
IC1	7805 5V regulator
IC2,3,4	4014/4021 shift register
IC5	Z86E0408 microcontroller*
IC6	ISD1416/1420 audio recorder
IC7	LM380N-14 audio amplifier
LED1	Red LED

Miscellaneous

PCB, 145 x 84mm, code 95vma2; 3.58MHz quartz crystal (XTAL1); three-pin header and jumper link (LK1); electret mic insert (MIC1); two NO pushbuttons, clickless type (PB1,2); two 8-way DIP switches (SW1,2); three 16-pin DIL sockets (IC2,3,4); 18- pin DIL socket (IC5); 28-pin DIL socket (IC6); 18 x PCB terminal pins.

Optional parts

12V DC PCB mounting relay (200 ohm coil, SPDT contacts); four three-way PCB mounting terminal blocks, three two-way PCB mounting terminal blocks.

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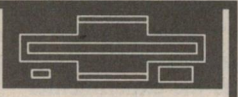

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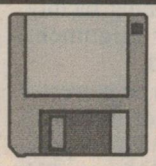

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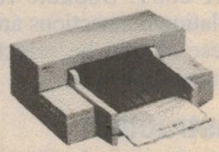

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DSE 'Discovery Series' Construction Project:

SIMPLE FUNCTION GENERATOR

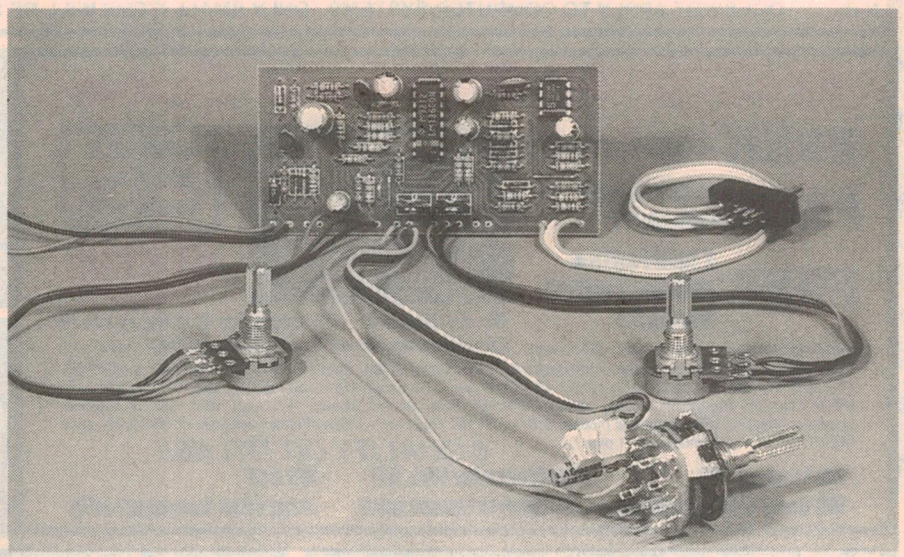
The third project in the new Discovery Series of learning kits from Dick Smith Electronics is a low cost circuit using only two ICs, which can produce either sine, square or triangle waveforms at any frequency between 10Hz and 100kHz. Designated as Cat. No. K-2802, the kit is available in DSE's stores for only $16.95.

This project will allow you to build a versatile, good quality function generator at a surprisingly low cost. Both the amplitude and frequency are voltage controlled, which gives the experimenter a variety of useful options. For example, by using two of the circuits together, you can produce an audio sweep generator or amplitude modulated audio generator.

The circuit includes a voltage regulator for good stability against varying supply voltage and loading. A trimming facility is provided for frequency alignment when a calibrated dial is used.

The function generator can be powered from a single 9V battery (not included) for portability, or from any DC supply between 8.5V and 15V. A 216-type 9V battery 'snap' connector is provided.

To facilitate construction of the function generator, the printed circuit board (PCB) has been designed to slide directly into a zippy box such as the DSE Cat. No. H-2851. Sockets for output and modulation connections are not provided, as these should be selected to suit the particular application.



Construction

The complete function generator except for main controls, frequency band capacitors and battery, is mounted on a single printed board. To mount components, first look at the overlay diagram to find the component name — e.g., D3 — then look down the parts list to find the value required. Some of the components must be mounted with a particular orientation, as described in this section.

Begin construction by fitting the three links to the PCB. The positions for these are visible in the overlay diagram; one goes 'lengthwise' between the positions for resistors R4 and R8, while the other two go 'crosswise' between R12 and trimpot VR1.

Next install the resistors on the PCB. There is a special expanded parts listing for the resistors, which shows the colour code for the particular resistance value required.

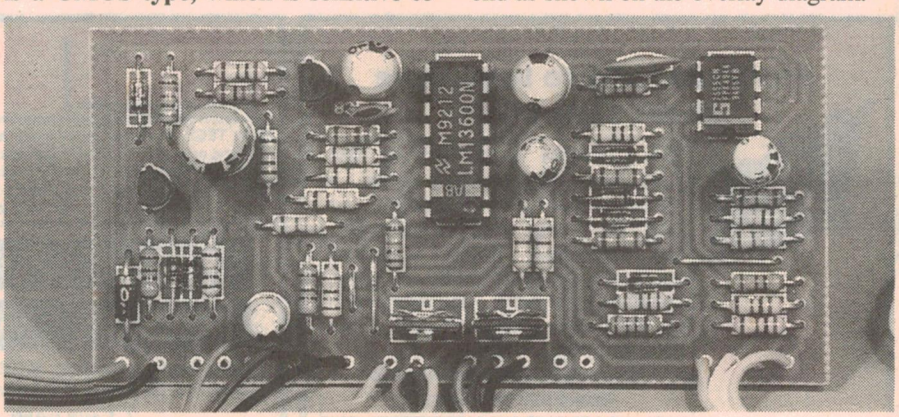
The last band of the colour code is the one furthest from the other bands. Resistors can be mounted in either direction, but it is good practice to mount them with their colour codes all in the same direction, for ease of reading the values.

Next mount the diodes D1-7 and ZD1. These have to be mounted in the right direction, with the stripe on the very end of the diode corresponding to the striped end shown on the overlay diagram.

Next mount the integrated circuits IC1 and IC2. **CAUTION: The TLC555 IC is a CMOS type, which is sensitive to static electricity. Please observe the following precautions:**

- Do not remove it from its protective foam until you are ready to install it,
- Avoid touching the pins with your fingers.
- Make sure that your soldering iron is properly earthed.
- Solder the power and earth pins of the IC to the board first.

Mount the IC's in the board so that the end with the notch in it is at the correct end as shown on the overlay diagram.



A close up view of the function generator board with all of its components fitted. Use this photo in conjunction with the PCB overlay diagram as a guide when you're assembling the project.

Next mount the transistors Q1 and Q2. Position them so that the flat face faces the correct direction, again as on the overlay. Do not push them down too hard into the PCB, as this will spread the leads excessively and may damage the internal connections.

Now mount the capacitors C1 and C6-12. Note that C1, C7, C9-12 are electrolytic types which must be mounted in the right direction. The negative lead is marked on the side of the capacitor with a negative (-) sign and the other lead, which is not marked, goes to the position that is marked with a positive sign (+) on the overlay. The two ceramic capacitors C6 and C8 can be mounted in either direction.

Then mount the two trimpots VR1 and VR3. It's a good idea to bend the leads over after they are inserted into the board, to give them a better mechanical hold — rather than just relying on the solder.

The final step in completing the contruction is to make the connections between the completed PCB assembly and the various off-board components — the frequency band switch SW1, the waveform switch SW2, the 'fine' frequency pot VR2, the output amplitude pot VR4, the various input/output connectors and the battery/power supply. Note that capacitors C2, C3, C4 and C5 mount on the rear of SW1, and are supported by its contact lugs.

How it works

The circuit of the function generator is based on a type of integrated circuit called an Operational Transconductance Amplifier, or 'OTA' for short. The particular device used here is the National Semiconductor LM13600. This device actually contains two OTA's, each with a Darlington buffer stage that can be externally connected if required.

The main difference between an OTA and the more common types of op-amps like the 741 is that the OTA provides an output *current* that is proportional to the differential input voltage, whereas the others provide an output *voltage* that is proportional to the differential input voltage.

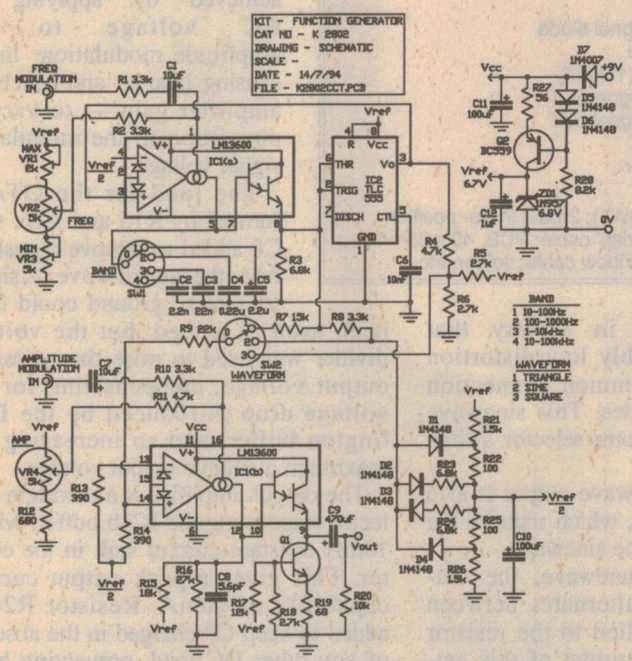
A feature of the OTA that makes it specially suited for this application is an extra input, called the amplifier bias input. The output current is proportional to the product of the differential input voltage (Vin = V(+) - V(-)) and the amplifier bias current (Iabc) i.e. it *multiplies* Vin and Iabc. This facility allows us to use direct voltage control of the amplifier. The maximum possible output current is equal to Iabc, so if the input is overdriven, the output is (+/-)Iabc for (+/-)Vin .

There are two supply voltages used in this circuit. One is an unregulated voltage (Vcc) which appears on the cathode of D7, the reverse polarity protection diode, which is 0.6V less than the supply voltage (e.g., 8.4V when using a 9V supply); the other is a regulated 6.7V (Vref), which is supplied by a shunt regulator comprising Q2, ZD1, D5-6 and R27-28. This regulator draws a constant current from the supply, which is split between the 6.8V zener diode ZD1 and the circuitry which operates from Vref (which draws a fairly constant current). The constant current source reduces the effects of a varying supply voltage on Vref.

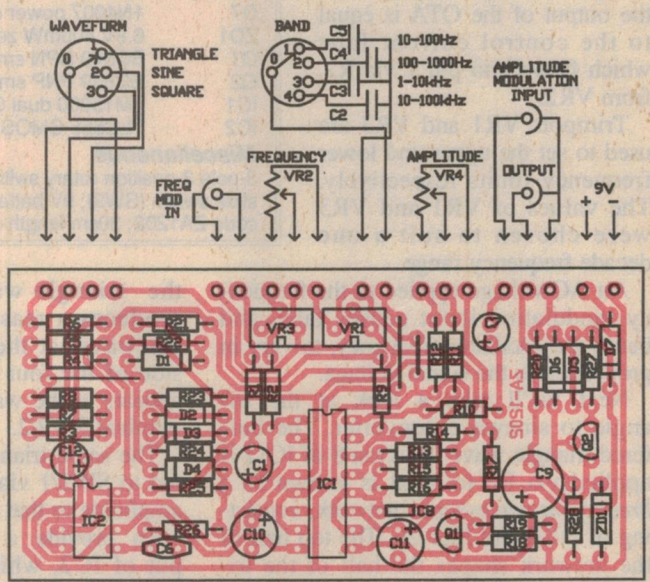
There are basically three sections to the main part of the circuit. Firstly, there is an oscillator using IC1a and IC2, with variable frequency control and a frequency modulation input. Secondly, there is a triangle to sinewave converter using diodes D1-4 and resistors R21-26, and a resistor network to equalise the amplitudes of the three

SPECIFICATIONS

Output Waveforms	Sine, square, triangle
Output Level	0-5Vp-p (load >250 ohms) 0-1Vp-p (load = 50 ohms)
Output Impedance	<10 ohms at 1kHz (independent of level setting)
Output Level Control	linear voltage control
AM Input	AC coupled max input 1.4Vrms (for 5Vp-p 100% mod.)
Output Frequency	10Hz-100kHz in four bands
Output Frequency Control	linear voltage control
FM Input	AC coupled max input 1.3Vrms



The schematic diagram for the function generator circuit. Op-amp IC1a forms a controlled current source to charge the capacitor selected by switch SW1.



This diagram shows the location of all of the parts on the function generator PCB, as well as the connections to the off-board components. Note that waveform switch SW2 is actually a small slider type, not a rotary.

waveforms. Thirdly there is an amplifier using IC1b and Q1, with level control and an amplitude modulation input.

The oscillator section itself consists of three parts. Firstly there is the OTA in IC1a, which is not used as an amplifier but as a switched current source feeding the frequency band determining capacitor (one of C2-4, as selected by SW1). Secondly there is the IC1a internal buffer, which is used to buffer the output of the OTA. Thirdly there is IC2, a 555 timer IC, which is being used here as a comparator with input hysteresis levels of (1/3)Vref and (2/3)Vref.

The way the oscillator works is as follows. When the voltage across the selected capacitor is *below* (1/3)Vref, the output of IC2 goes high (Vref), causing the OTA to charge the capacitor with a constant current equal to Iabc. When the capacitor voltage *exceeds* (2/3)Vref, the output of IC2 goes low (0V) causing the OTA to discharge the capacitor at the same rate. The resulting waveform across the capacitor is a triangular wave, which is symmetrical about (1/2)Vref with a peak-to-peak amplitude of (1/3)Vref.

If there is no frequency modulation applied, the charge/discharge current from the output of the OTA is equal to the control current Iabc which flows into pin 1 via R2, from VR2.

Trimpots VR1 and VR3 are used to set the upper and lower frequency limits respectively. The values of VR1 and VR3 were chosen to suit a one decade frequency range.

An AC voltage applied to the frequency modulation input causes Iabc, and hence the oscillator frequency, to vary in proportion to the signal voltage.

Next we'll take a look at the triangle to sinewave converter. The buffered triangle wave from pin 8 of IC1a is applied via R8 to what is known as a *breakpoint waveshaper* network, consisting of D1-4 and R21-26. The top half of the network shapes the half of the triangle waveform that is higher than (1/2)Vref, while the bottom half of the network shapes the lower voltage half of the triangle waveform.

The way the converter works is that the diodes are biased by the voltage divider made of R21, R22, R25 and R26 (the centre point of which also provides (1/2)Vref for biasing the two OTA's), so that they conduct at different voltages. This has the effect of rounding off the triangle wave in a way that produces a reasonably low distortion sinewave, at the common connection side of the four diodes. This sinewave appears at the waveform selector switch terminal SW2/2.

The same triangle wave output is also fed to SW2/1 via R7, which reduces the amplitude to that of the sinewave.

To provide a squarewave, the output of IC2, which alternates between Vref and 0V, is applied to the resistor network R4-6. The output of this network, which is applied to SW2/3, is a squarewave which is symmetrical about (1/2)Vref (as are the triangle and sine waves), and with the same amplitude as the sine and triangle waves.

Looking now at the amplifier section, the selected sine, square or triangle wave from SW2 — which has an amplitude of about 0.7Vpk — is applied via attenuator R9/R14 to the non-inverting input of the amplifier OTA at pin 14.

The level that appears at this input has a peak amplitude of about 20mV. It has to be at this low level to minimize distortion without the use of feedback. This particular OTA device actually has inbuilt linearising diodes (shown as part of the OTA circuit symbol), which can be biased to remove this particular non-linearity, but these were found to reduce the gain too much, and so were not used.

In the absence of any amplitude modulation input, the gain of the amplifier, and hence the output level, is determined by the control current (Iabc) fed into pin 16 via R11, from VR4. R12 raises the voltage at the bottom end of VR4 to about 0.8V, because this is about the minimum voltage required to start Iabc flowing (the voltage at pin 16 varies between about 0.8V and 1.4V, depending on current and temperature).

Amplitude modulation is achieved by applying an AC voltage to the amplitude modulation input, causing Iabc — and hence the amplifier gain — to vary in proportion to the modulation signal voltage.

The load for the OTA is formed by R15 and R16, with C8 added to remove overshoot from the square wave. A single resistor to ground could have been used as a load, but the voltage divider was used to raise the quiescent output voltage, compensating for the voltage drop introduced by the Darlington buffer, and so increasing the maximum available output voltage.

The output amplifier is a common collector stage using the IC1b buffer, with a 10mA constant current sink in the emitter. This gives a peak output current capability of 10mA. Resistor R20 is added to keep C9 charged in the absence of any other DC load, preventing large transients when the output of the function generator is connected to a circuit under test. ❖

PARTS LIST

Resistors

(All 0.25W/5% metal film unless specified)

		4 Band 1%	5 Band 1%
R1,2,8,10	3.3k	Org Org Red Brn	Org Org Blk Brn Brn
R3,23,24	6.8k	Blu Gry Red Brn	Blu Gry Blk Brn Brn
R4,11	4.7k	Yel Vio Red Brn	Yel Vio Blk Brn Brn
R5,6,18	2.7k	Red Vio Red Brn	Red Vio Blk Brn Brn
R7	15k	Brn Grn Org Brn	Brn Grn Blk Red Brn
R9	22k	Red Red Org Brn	Red Red Blk Red Brn
R12	680 ohms	Blu Gry Brn Brn	Blu Gry Blk Blk Brn
R13,14	390 ohms	Org Wht Brn Brn	Org Wht Blk Blk Brn
R15	18k	Brn Gry Org Brn	Brn Gry Blk Red Brn
R16	27k	Red Vio Org Brn	Red Vio Blk Red Brn
R19	68 ohms	Blu Bry Blk Brn	Blu Gry Blk Gld Brn
R17,20	10k	Brn Blk Org Brn	Brn Blk Blk Red Brn
R21,26	1.5k	Brn Grn Red Brn	Brn Grn Blk Brn Brn
R22,25	100 ohms	Brn Blk Brn Brn	Brn Blk Blk Blk Brn
R27	47 ohms	Yel Vio Blk Brn	Yel Vio Blk Gld Brn
R26	8.2k	Gry Red Red Brn	Gry Red Blk Brn Brn
VR1	2k	5mm vertical trimpot	
VR2,4	5k	16mm linear potentiometer	
VR3	5k	5mm certical trimpot	

Capacitors

C1,7	10uF	16/35VW RB electrolytic
C2	2.2nF	100V MKT (.0022, 222)
C3	22nF	100V MKT (.022, 223)
C4	0.22uF	100V MKT (220n, 224)
C5	2.2uF	100VW RB electrolytic
C6	10nF	50V ceramic (0.01uF, 103)
C8	5.6pF	50V ceramic
C9	470uF	10VW RB electrolytic
C10,11	100uF	16VW RB electrolytic
C12	1uF	50VW RB electrolytic

Semiconductors

D1-6	1N4148 or 1N914 signal diode
D7	1N4007 power diode
ZD1	6.8V 400mW zener (1N957)
Q1	BC549 NPN small signal BJT
Q2	BC559 PNP small signal BJT
IC1	LM13600 dual OTA
IC2	TLC555 CMOS timer

Miscellaneous

3-pole 3-position rotary switch (SW1); 2-pole three- position slide switch (SW2); 9V battery 'snap' cable; PCB, 43 x 88mm, code ZA1202; 30cm length of rainbow cable; solder, etc.

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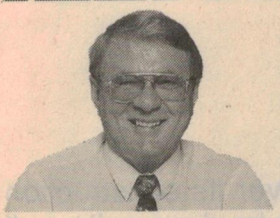

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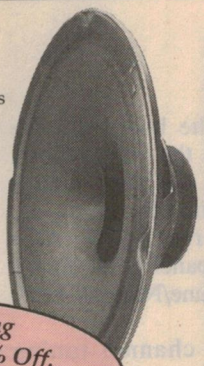

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Resistance Ranges: .....200 Ohm, 2k Ohm, 20k Ohm, 200k Ohm, 2M Ohm
Battery Test Ranges:.....1.5V, 9V Loaded
Battery Test Current:.....1.5V 100mA, 9V 6mA

Q 1056 Normally $59.95

This Month Only $39.95

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Remote Controlled Economy Car Alarm

Every few minutes a car is stolen is Australia - Statistics Show with an alarm fitted, the chances of your car being stolen are greatly reduced!

Protect Your One of Your Biggest Investments for a Mere $89

Features: • Remote control arming and disarming • Supplied with one keyring remote control • 125dB siren • Flashes headlights when activated • Flashing LED dash light when armed to deter would be thieves • Audible confirmation of arm/disarm • Can be wired to protect all doors, boot and bonnet • Automatically resets after 60 seconds • Fully self contained and compact • Provision for optional 9V nicad backup battery (S 5124)

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S 5224 Additional Remote Control **$37.75**
S 5124 Optional 9V Battery Backup **$17.75**

Very Simple to Install
Requires Only Minimal Wiring

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4 Sector Alarm Panel

Huge Saving $100 Off

The deluxe S 5485 4 sector alarm panel features a user selectable 4 digit pin number allowing you to arm and disarm the alarm via the inbuilt digital keypad. By using 'End of Line Resistor' technology, all 4 independent sectors accept almost any type of sensor (Normally Open and Normally Closed). Any sector can be individually isolated, (e.g. when at home you may want to turn on perimeter sensors, allowing movement inside). Includes a 24 hour panic and tamper per sector. Alarm pre-warning reminds you to disarm on entry. Constructed in sturdy steel case with lock. Includes easy to follow installation instructions.

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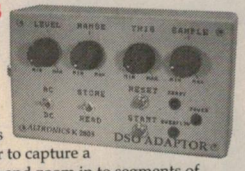
Digital Storage C.R.O. Adaptor for P.C.'s Kit



(See EA Jan '93) This great kit enables a P.C. user to capture a waveform and zoom in to segments of interest then save them to disc. The unit has 32K of storage memory and a sampling rate of over 600K samples per second. Input level of up to 2.5 Volt. Full sampling rate between 15K s/s to over 600K s/s. Input impedance of 1M ohm.

K 2805 Normally $63.50

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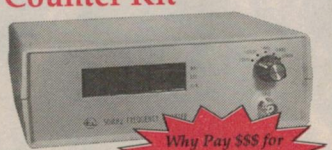
K 2806 PC 5.25" Disk Software **$19.95**

50 Mhz Frequency Counter Kit



Why Pay $$$ for Commercial Equivalents

(See EA Feb '93) This frequency counter kit offers high performance with out a high price tag. Features include an accurate 4 digit bright LED display, 5 ranges of 10kHz, 100kHz, 1MHz, 10MHz, 50MHz and a BNC type input connector. Ideal for servicing etc. Supplied complete with professional screen printed aluminium front panel.

K 2512 $89.95

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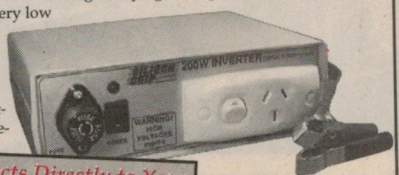
(See SC Feb '94) This compact 200W Inverter can drive many mains power appliances including power tools, fluorescent and incandescent lights, TV's etc, using a 12V power source. It is ideal when camping, on building sites, on farms or as part of a solar power installation. This inverter, uses high frequency switching techniques which eliminates the need for bulky, heavy transformers enabling a very light weight compact unit.

Features: • Small physical size • Very low standby current • Modified square wave output • Peak-peak voltage equal to mains sine wave • Low battery voltage shutdown • 30A - over current limiting • Fuse protection • Fully isolated output for safety • 2kg mass



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Construction Project:

NEW STEREO TV SOUND RECEIVER - 2

In this second article describing our new stereo TV sound receiver, we cover its construction and adjustment. There is very little setting up needed, and the alignment can be done quite well using off-air signals.

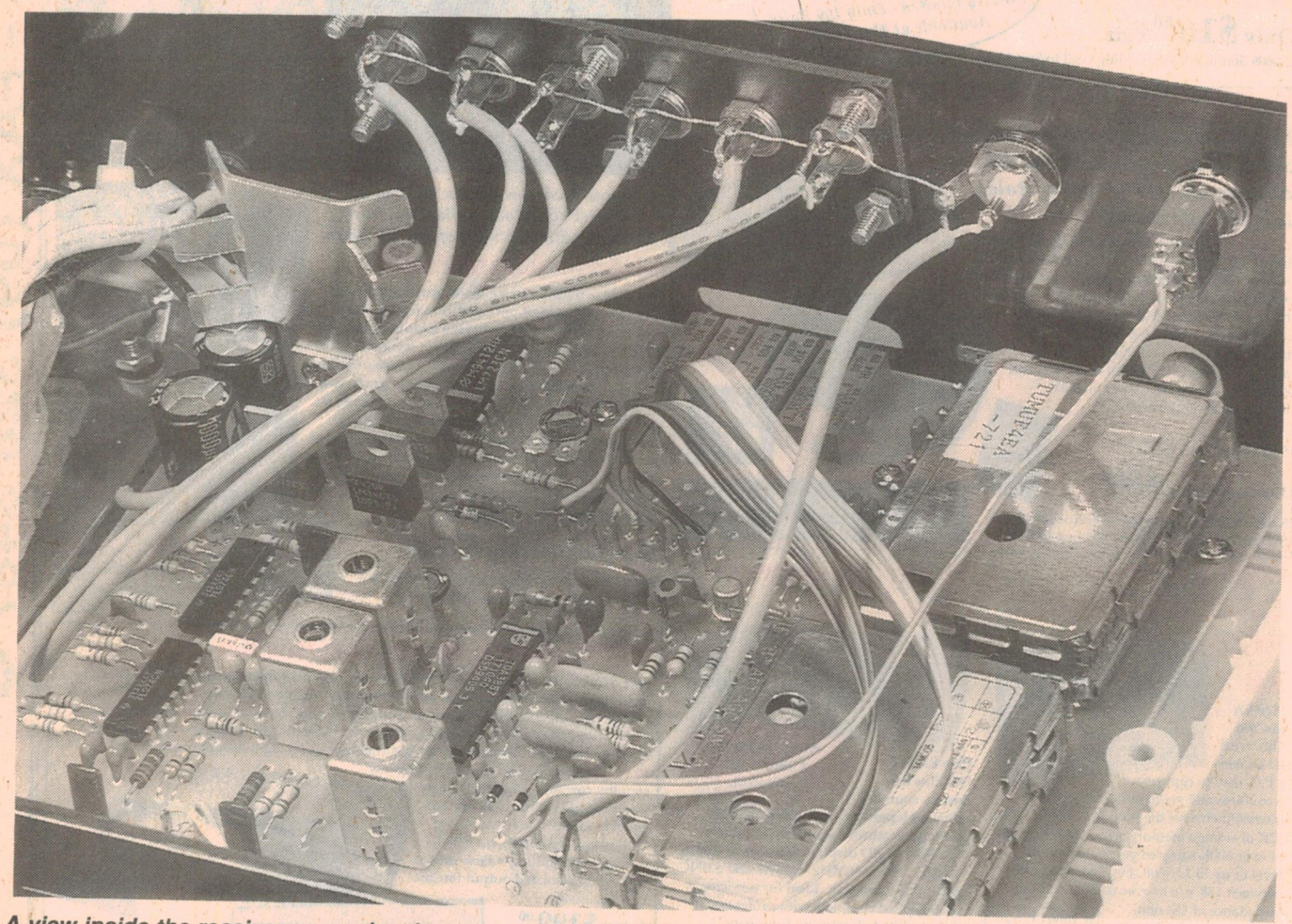
by JIM ROWE

The complete sound receiver is housed in one of the standard four-piece plastic utility cases, measuring 250 x 190 x 80mm. These are stocked by most of the major suppliers, and are readily available. Inside the case, most of the parts mount on a single printed circuit board measuring 165 x 137mm, with the code 95tvs1.

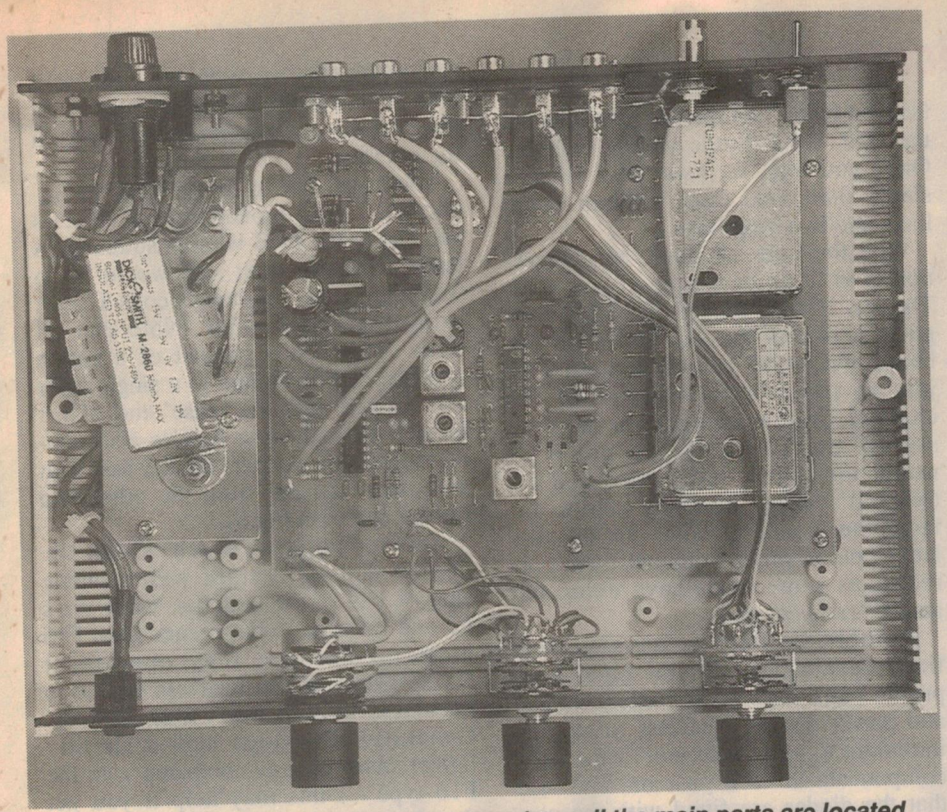
Not mounted on the board are the front panel controls, the 30V/500mA power transformer, and the various input and output connectors which are all mounted on the rear panel. Also mounted on the rear panel is the mains fuseholder, and the Tune/Normal AFC-defeat switch SW3.

Although the six channel tuning preset pots RV1-6 are mounted on the PCB, they are located in the centre of the rear edge, so that they can be adjusted easily via an elongated hole in the rear panel.

This can be seen in the 'rear view' photo, which also shows the way that the tuner module's antenna input is similarly accessible via a larger round



A view inside the receiver case, showing many of the components. The two modules are visible at lower right, and the author's custom-made heatsink at upper left.



A general view inside the case, showing where all the main parts are located.

clearance hole in the lower left-hand corner of the panel.

The other connectors on the rear panel are a group of six RCA- type audio sockets for the various audio outputs, a BNC socket for the composite video output, and a standard IEC panel-mounting plug for the mains input.

On the front panel, the neon-illuminated mains rocker switch is fitted at the left-hand end (looking from the front), with the three main operating controls to its right. First along is the volume control, then the Mono/Stereo/Bilingual1/Bilingual2 switch SW2, and finally the channel selector switch SW1.

Inside the case, the power transformer is mounted securely on a small earthed aluminium plate, for safety. The plate measures 110 x 45mm, and is cut from 1mm-thick aluminium sheet. In turn the plate is attached to the bottom of the case, alongside the main PCB. Note that the transformer is mounted on the plate at a small angle, to minimise the amount of leakage flux reaching the audio ICs on the board while still clearing the nearby case fastening pillar.

PCB assembly

Moving now to the PCB itself, as you can see from the internal photos the tuner and IF modules are mounted on their side at one end. This has been done to simplify their mounting arrangements, and also in an attempt to forestall possible future problems due to minor changes in case dimensions or pin spacing. (Manufacturers have been known to make such changes!)

Each of the two modules is attached to the top of the board via four PCB terminal pins, with one near each corner. After soldering these to the copper under the board in the usual way, each pin is bent over above the board so that they contact the side of the module, and together locate it in the right position. Then using a reasonably high-powered soldering iron, each pin is quickly soldered to the module case.

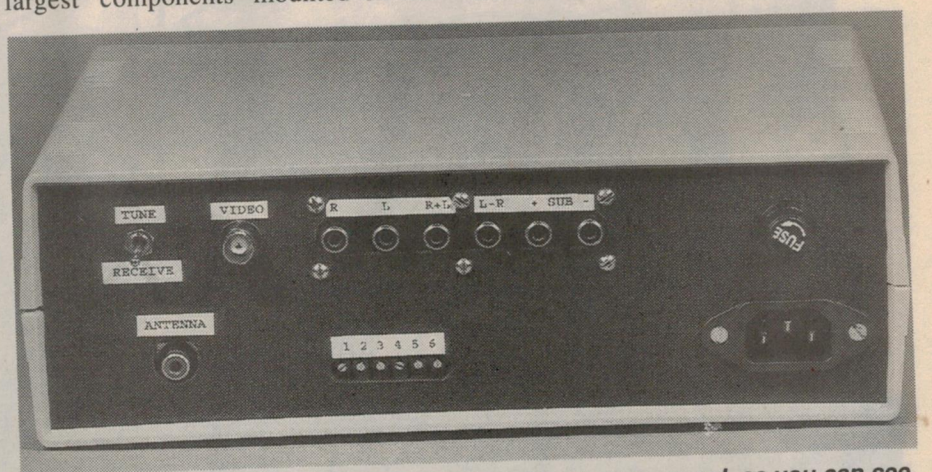
Because the two modules are the largest 'components' mounted on the board, it's probably best to mount them in this way first, before fitting anything else. This stage is completed by connecting each terminal pin of the two modules to the corresponding PCB pad below it, using a short length of tinned copper wire.

I bent each wire with a small loop at the top, to fit around the module pin, and a straight 'tail' to go down through the PCB hole. This let me solder both joints without the wire links falling off all the time.

With the modules installed, I suggest that your next step is to fit the rest of the PCB terminal pins around the board. There are quite a few of these, but they're worth using because they make it much easier to fit the various off-board connection wires.

Most of the pins are located along the front edge of the board, for the front-panel control connections, or along the side near the power transformer for the various audio outputs and AC power inputs. However there are also four pins near the front of the IF module, for the composite video output and Tune/Normal switch connections, and two rows of seven pins down near the channel tuning preset pots at the centre rear of the board, for the connections to the channel selector switch sections SW1a/b.

After the pins are fitted, it's probably a good idea at this stage to fit the various wire links as well. There are not very many of these, but they're best fitted early to prevent trouble later should they be forgotten. There are two near the front of the board (one near coil L2, the other near U2), one near the rear of the board (just to the rear of preset pot RV7) and another just to the rear of the centre of the board, near R17 and R18.



All of the inputs and outputs are brought out to the rear panel, as you can see. The six preset pots used for channel fine tuning are accessible via the oblong hole in the lower centre of the panel.

Stereo TV Sound Receiver - 2

In addition, there are six further links fitted between the two rows of pins used for the SW1 connections, and used to 'program' your receiver for the band switching needed for the TV channels in your area.

The link programming scheme is quite straightforward. The board has an array of 24 holes, arranged in six rows of four and with each row used for programming one of the receiver's six preset channels 1-6.

All you have to do is decide which of your local channels you want on each position of SW1, and then determine the band they're in (low VHF, high VHF or UHF). Then you simply fit each link accordingly, using the PCB overlay as a guide.

Each of the links runs between the hole in its row nearest the SW1b connection pins, and *one* of the three other holes to its rear, according to the band required.

An example will hopefully make this clear. In my case, in Sydney, I wanted to program the prototype receiver to receive channels 2, 7, 9, 10, 28 and 31, in that order. So the first link was fitted for the low VHF band (first hole), the next three for the high VHF band (second hole), and the last two links for the UHF band (furthest/rearmost hole). Or if you like, in rows 1-6 I fitted a single short link, three medium-length links and two long links.

With the links all fitted, my suggestion is to fit all of the preset pots next. The six 10-turn tuning pots RV1-6 all go in a row at the centre rear of the board, with +28V adjustment pot RV7 just on the transformer side of the channel programming links and the stereo matrix balancing pot RV8 nearer the centre, just behind coil L4 (when it's fitted). You may need to enlarge the mounting holes for the two latter pots in order to mount them correctly, as some types have elongated and/or 'cranked' pins.

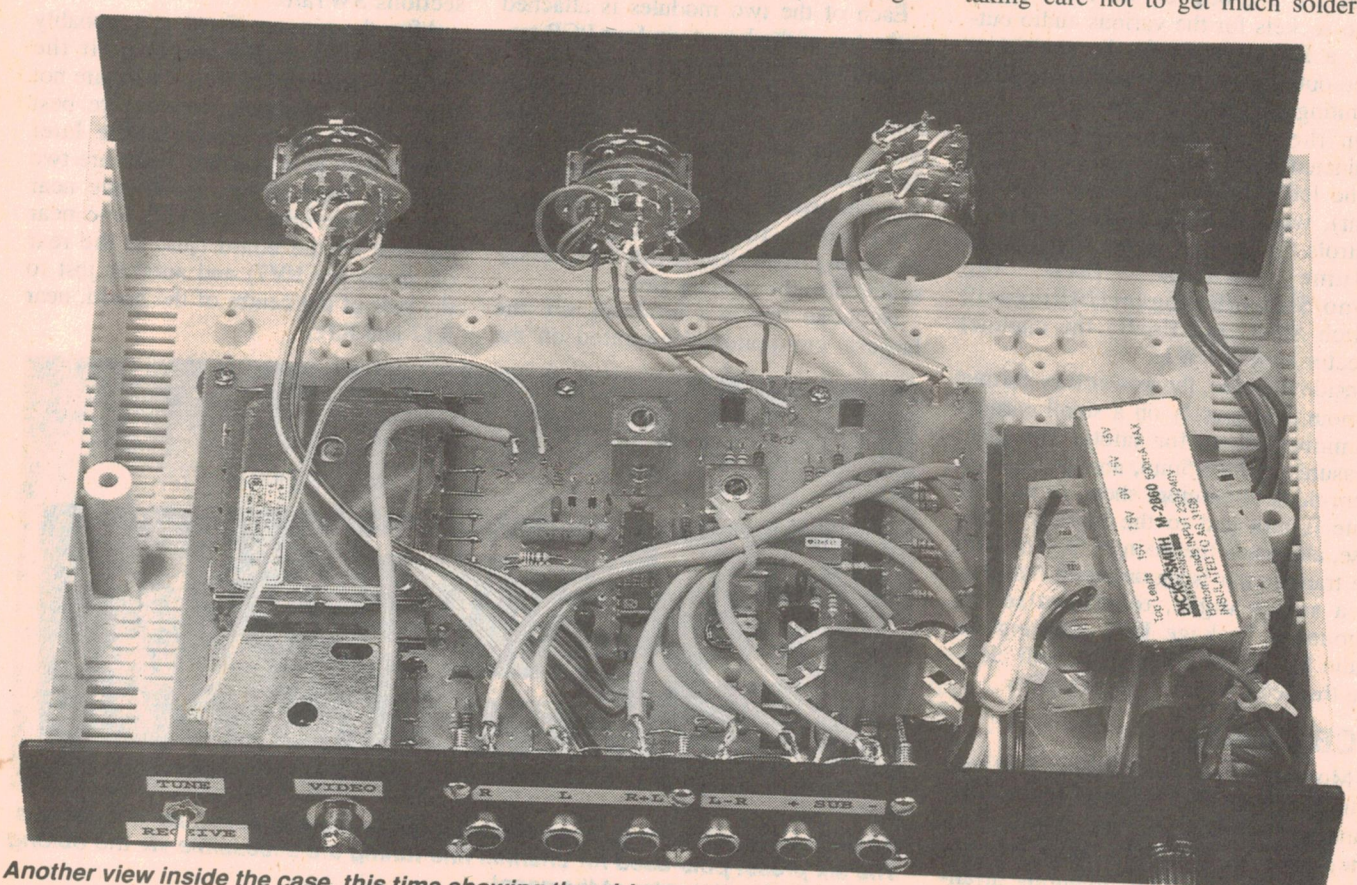
Probably the fixed resistors are best fitted next, along with the other low-profile parts such as the zener, varicap and power diodes. Needless to say it's important to make sure you fit the right components in each position, and also that the diodes are fitted with the correct orientation as indicated on the overlay diagram.

The smaller monolithic, ceramic, MKT and solid tantalum capacitors are best fitted next, followed by the larger electrolytics — again taking care to fit both of the latter polarised types with the correct orientation as marked on the overlay.

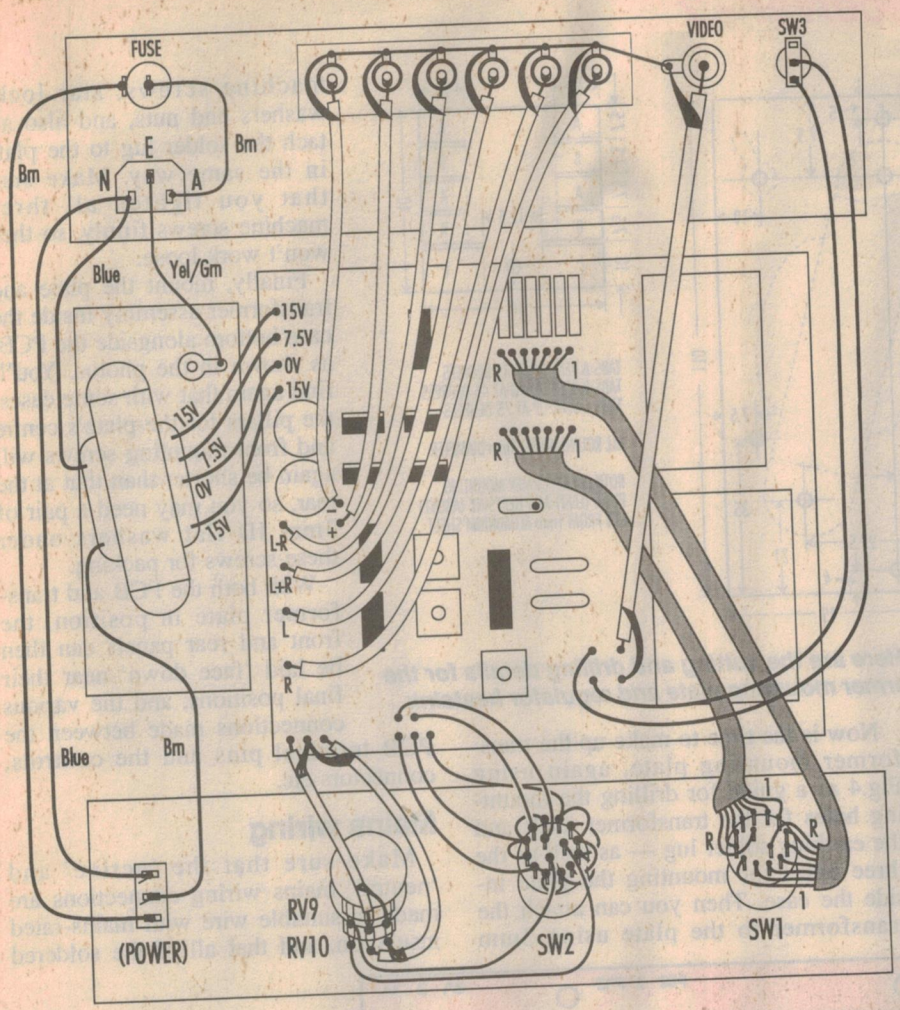
You might like to fit the small RF inductor L1 next, mounting it as close as you can to the PCB without straining its leads. Then the next step would be to wind the three slug-tuned coils L2-L4, using Fig.3 as a guide. Note that all three of the coils consist of a single winding, tightly wound in a single layer and located near the 'base' end of the former. In each case they're also connected to the two pins on the base that are spaced further from the other two (pins 5 and 6, in Fig.3).

Another point to watch is that the 36MHz coil L2 is fitted with a tuning slug of F29 ferrite material, while coils L3 and L4 need to have slugs from F16 material because they operate at 5.5/5.74MHz. If you inadvertently swap the slugs, the coils won't tune correctly. Generally F29 slugs look a slightly lighter shade of grey compared with the F16 type — this may help if you get them mixed up!

Once the coils are wound on and/or slipped on the formers, you can bare the ends and solder them into the correct base 'pins' (actually hollow tubes) — taking care not to get much solder on



Another view inside the case, this time showing the wiring to the front panel controls, in greater detail.



This overall wiring diagram should clarify any aspects of the receiver's off-board wiring not made clear by the photographs.

the outside of the pins, or you'll have trouble mounting the completed coil assembly into the board. Then you can fit the shield can, bending over the small lugs at the bottom if you wish (it's not essential) before fitting each coil into the board.

Don't forget to mount the 6-turn coil in the L2 position, and the 10-turn coils in the L3/L4 positions. Otherwise you'll again end up with strange problems later!

Again, you may need to enlarge the PCB holes to accept the coil pins, as these are around 1.5mm in diameter.

The ceramic filters and SAW filter can be fitted next. You can't confuse the SAW filter with the other two, even though they look rather simular. The SAW filter has five pins, all at 0.1" spacing, while the two filters have only four — two at each end, with a 0.3" gap in the centre. Fit SAWF1 so that its orientation paint spot is at the end nearest RF inductor L1.

The main thing to watch with the two ceramic filters is that you fit the 5.74MHz unit to the CF1 position, nearer to the rear of the board, and the 5.50MHz unit to the CF2 position. These filters seem to be symmetrical, and not unduly critical regarding orientation; however according to the manufacturer's data they should be fitted with their numbered side towards the *rear* of the board, in this case.

With the filters in place you're ready for the last components to be added to the board: transistor Q1 and the integrated circuits U1-8. The orientation of each of these is shown on the PCB overlay diagram; note that the transistor is fitted with its orientation lug pointing diagonally across the IF module. It should be fitted with the body as close to the PCB as possible, without straining the leads. The four three-terminal regulators U4, U5, U6 and U8 are all fitted with their heatsink tab side towards the rear of the board. Positive 12V regulator U4 is the only one that needs a heatsink. However this one does need quite a respectable heatsink, as it dissipates around two watts.

As the component spacing is a little tight in this part of the board, it isn't easy to fit any of the currently available commercial heatsinks with a sufficiently low thermal resistance. I ended up fashioning a suitable 'flag' type heatsink from a small scrap of 1mm aluminium sheet, as shown in Fig.4. It attaches to the device in the usual way, using a 3mm machine screw, star lockwasher and nut (with the wider 'staggered lug' section above clearing the electrolytic caps and other regulators, and the narrower lower section pointing to the rear of the PCB). A small smear of thermally conductive grease on the tab of the regulator before fitting the heatsink will help ensure effective cooling.

Your PCB assembly phase should now be complete, and you can move to the next stage of preparing the case front and rear panels. If you're building the project from scratch, rather than from a kit, your next operation may therefore be to drill and cut the various control/connector mounting holes in the two panels.

Even if you're assembling a kit, and the main holes have already been punched, you may want to add extra niceties such as short 'blind' holes in the inside of the front panel for the locating spigots of the switches and pot,

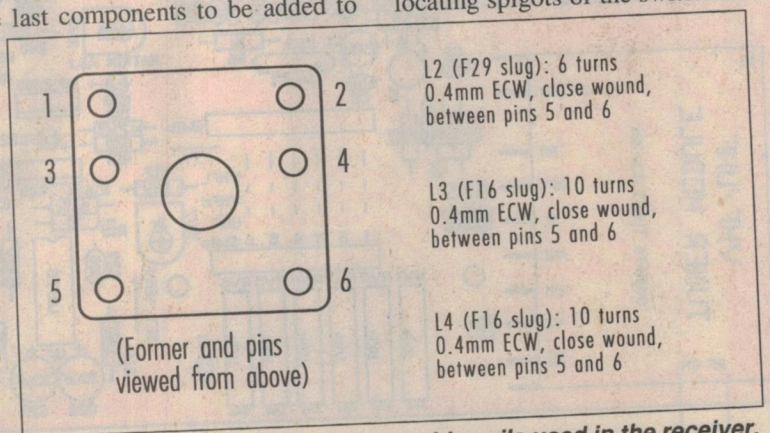


Fig.3: Winding details for the three adjustable coils used in the receiver.

and a similar (but smaller) hole on the inside of the rear panel for the spigot of the Tune/Normal toggle switch SW3. Adding these holes only takes a few minutes, and stops the controls from working loose and rotating on their axes later...

Once you've cut all of the holes in both panels, the controls and connectors can all be fitted in the usual way. Then you're ready for the final assembly.

The completed PCB subassembly is mounted in the bottom of the case in the position shown in the photos, using seven of the 3mm self-tapping screws which come with the case. Note that PCB holes for the three screws along the *front* of the board line up with moulded mounting pillars which are about 2mm shorter than many of the others (including those for the rear four screws), in one of the readily-available cases. If you have this type of case, use a couple of small 3mm ID flat washers under the PCB at each screw hole, to prevent the board from being strained when the screws are tightened.

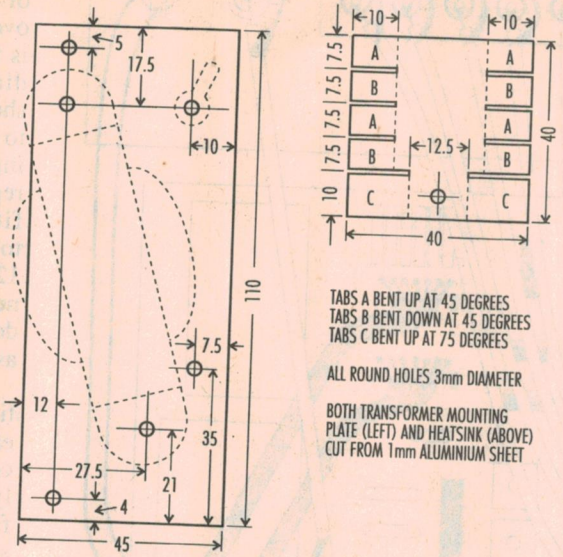


Fig.4: Here are the cutting and drilling details for the transformer mounting plate and regulator heatsink.

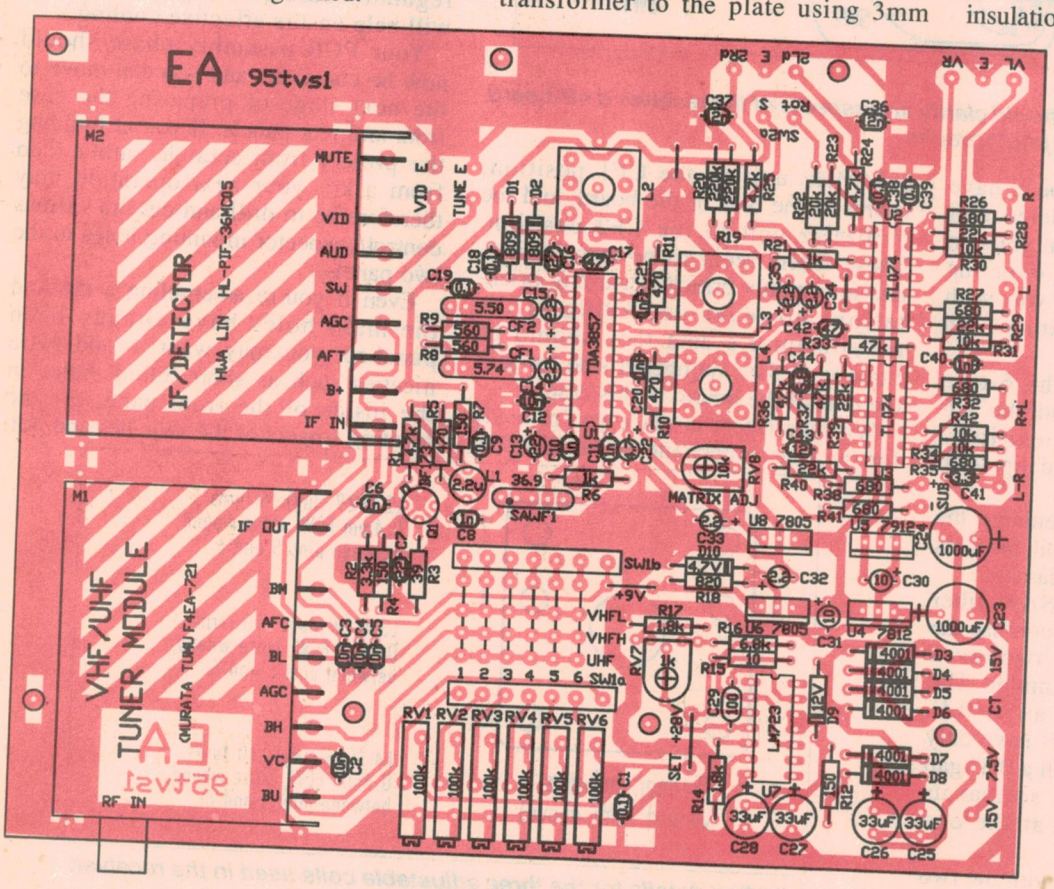
Now is the time to make up the transformer mounting plate, again using Fig.4 as a guide for drilling the mounting holes for the transformer itself and the earthing solder lug — as well as the three holes for mounting the plate inside the case. Then you can attach the transformer to the plate using 3mm machine screws, star lockwashers and nuts, and also attach the solder lug to the plate in the same way. Make sure that you tighten all three machine screws firmly, so they won't work loose.

Finally, mount the plate and transformer assembly inside the case bottom alongside the PCB, as shown in the photos. You'll find again that with some cases, the pillars for the plate's centre and front mounting screws will again be shorter than that at the rear, so you may need a pair of 3mm ID flat washers under these screws for packing.

With both the PCB and transformer plate in position, the front and rear panels can then be laid 'face down' near their final positions, and the various connections made between the PCB terminal pins and the controls, connectors etc.

Mains wiring

Make sure that the 'active' and 'neutral' mains wiring connections are made in suitable wire with mains-rated insulation, and that all of the soldered



As usual, here is the PCB overlay diagram for the receiver, showing the location and orientation of all parts.

joints and their lugs are fitted with reliable sleeving to prevent accidental finger contact. Small diameter heatshrink tubing is excellent for this.

The earth lug of the IEC connector is wired directly to the solder lug on the transformer mounting plate, using mains-cable 'earth' wire with green/yellow colour coded insulation. The 'A' lug of the connector is connected to the *end* or axial connection lug of the fuseholder, while the *side* lug of the fuseholder connects to the end lug of the mains switch which does NOT have a wire joined to it and disappearing inside the switch.

This 'active' wiring is all made using mains-cable wire with *brown* (or red) insulation, and the transformer's primary wire with the same colour insulation is wired to the CENTRE lug of the mains switch (which *does* have a wire disappearing inside the switch).

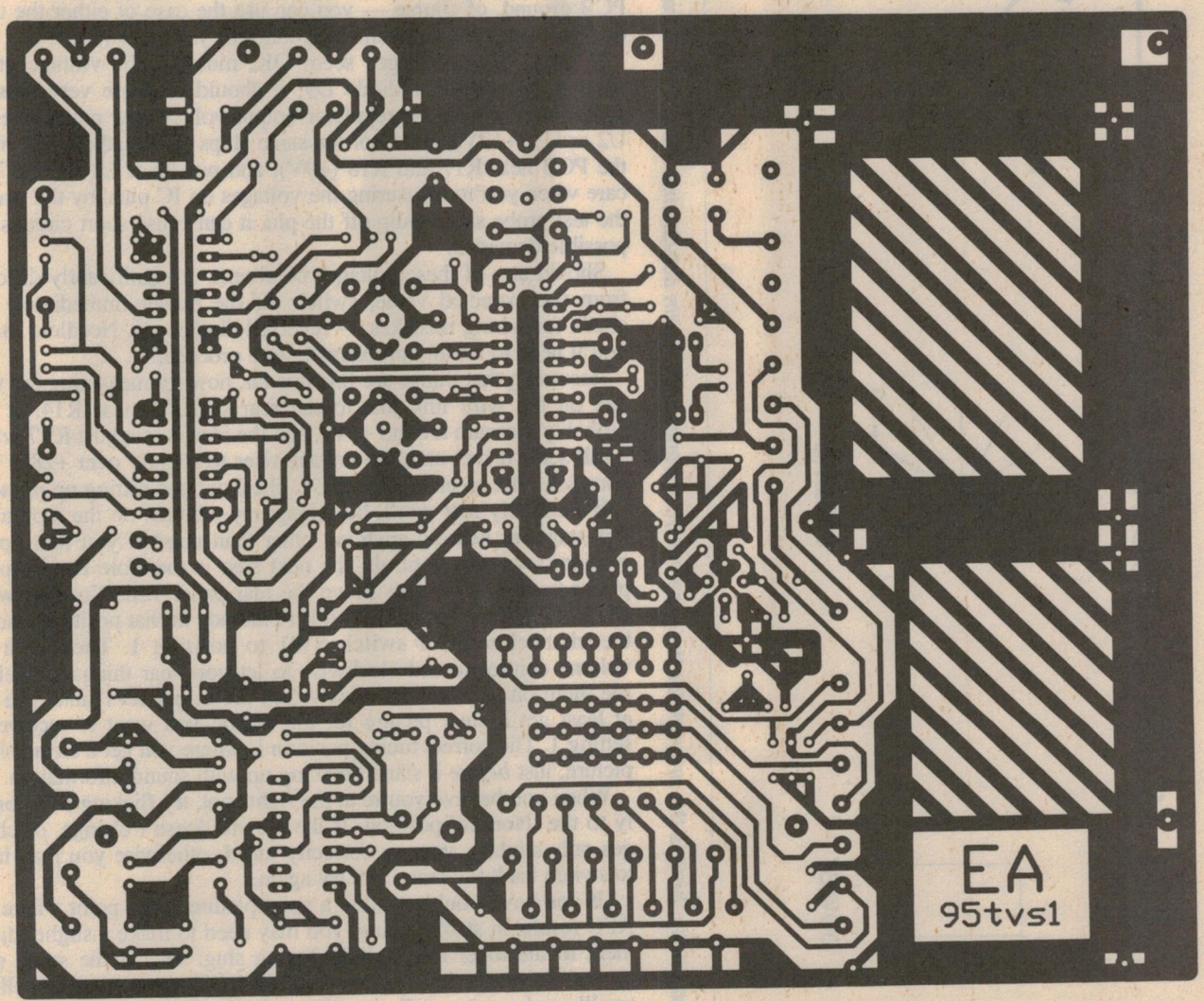
The 'N' lug of the IEC connector has two wires connected to it, one of which is the remaining *blue* transformer primary wire. The other wire, with the same colour insulation, runs to the remaining END lug of the mains switch (which again *does* have a wire disappearing into the switch body).

In addition to fitting insulating sleeves over all of the mains wiring connections, it's a good idea to use a few nylon cable ties to bundle the wires together securely for increased safety, as shown in the photos. The idea of this is that if one joint should fail, the other wires will hold the wire in position and prevent it from 'wandering around' and possibly contacting the low-voltage circuitry with disastrous results.

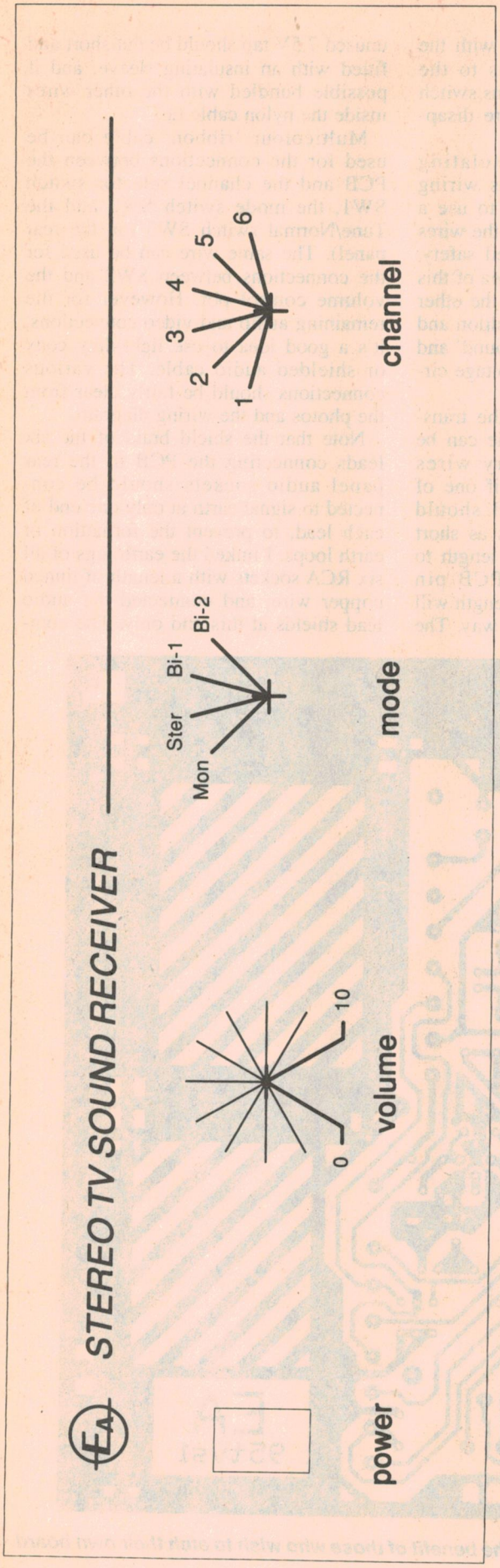
On the secondary side of the transformer, another nylon cable tie can be used to hold the secondary wires together, to prevent damage if one of the connections to the PCB should come adrift. Keep these leads as short as possible, with just enough length to reach to their respective PCB pin without any strain; excessive length will only cause them to get in the way. The unused 7.5V tap should be cut short and fitted with an insulating sleeve, and if possible bundled with the other wires inside the nylon cable tie.

Multicolour 'ribbon' cable can be used for the connections between the PCB and the channel selector switch SW1, the mode switch SW2 and the Tune/Normal switch SW3 (on the rear panel). The same wire can be used for the connections between SW2 and the volume control pot. However for the remaining audio and video connections, it's a good idea to use light-duty coax or shielded audio cable. The various connections should be fairly clear from the photos and the wiring diagram.

Note that the shield braid of the six leads connecting the PCB to the rear panel audio sockets should be connected to signal earth at only one end of each lead, to prevent the formation of earth loops. I linked the earth lugs of all six RCA sockets with a length of tinned copper wire, and connected the audio lead shields at this end only. The com-



Here is the receiver PCB etching pattern, reproduced actual size for the benefit of those who wish to etch their own board.



And finally, here is the artwork for the receiver front panel once again actual size. It's shown here in negative form, by the way.

mon audio socket earth is also connected to the earth of the BNC video socket, and connects to the PCB earth via the shield braid of the video lead — which *is* connected at each end, like the leads between the PCB and the volume control.

After completing all of the connections, spend a few minutes checking over your work to ensure that everything is according to plan. Then you should be ready for the testing and alignment phase.

Testing and alignment

For this operation, you'll need to connect the antenna input of the receiver's tuner module to your TV antenna, perhaps via a splitter unit so that your existing TV set still receives signals as well. You'll also need to connect the R and L audio outputs to a suitable stereo amplifier, so that you can monitor the audio, and also feed the receiver's video output to either a video monitor, to your TV's direct video input if it has one, or via a VCR if it hasn't. (Monitoring the picture makes tuning the sound receiver much easier.)

Before applying the power, turn the volume control fully anticlockwise and the mode switch to Mono. Also turn preset pot RV7 to the fully anticlockwise position, and RV6 to its centre position. Then switch on the power, and with your DMM or multimeter quickly check the voltages at the output of the bridge rectifier. You should find about +21V at the cathode (band) end of D3 or D6, and -21V at the anode end of D4 or D5. These voltages are relative to PCB ground, of course — you can use the case of either the tuner or IF modules as a convenient ground for your meter.

If these basic voltages seem OK, measure the voltage at the banded end of zener diode D9; it should measure very close to +33V. Then check the regulator output voltages, at pin 4 of either U2 or U3 (+12V), pin 11 of the same chips (-12V), the wire link on the PCB near R17 and R18 (+9V), and pin 19 of U1 (+5V). Take care when you're measuring the voltages on IC pins, by the way; if the test probe should slip off the pin, it can cause short circuits and possible damage...

Should any of these voltages be absent, or significantly different from the expected value, switch off the power immediately and check for wiring mistakes — reversed diodes, etc. Needless to say, you'll need to fix any problems before proceeding.

Assuming that things are fine this far, now try measuring the voltage on the wire link just to the rear of RV7, near R14. It will probably measure around +24V, and the idea is to adjust RV7 with a small screwdriver until the voltage rises to slightly over +28V. This completes the receiver's basic DC checkout and setting up phase.

It's unlikely that you'll be seeing any pictures on the monitor at this stage, or hearing anything other than noise if you turn up the receiver's volume control. The next step is therefore to set up the preset tuning. To do this move the rear panel Tune/Normal switch SW3 to its 'Tune' position, if it isn't already in that position, and set the channel selector switch SW1 to position 1. Then with the volume control turned clockwise to let you hear things as well as see them on the monitor, slowly turn preset pot RV1 until you can at least get a clear picture for the station you want to receive on setting 1. The correct tuning position is where you get a clean, sharp picture, just *before* it starts breaking up with sound information.

When you believe you're at the right spot, try flicking SW3 briefly to the 'Normal' position. If the picture doesn't change, or changes only slightly, you are correctly tuned; otherwise you may have to switch back to 'Tune' and try again.

(If you have trouble getting a good picture at the point where the AFC results in stable tuning, you may need to make a slight adjustment to the tuner module's IF tuning slug. This is the small slug accessible via the hole just near the IF OUT pin; it's very small, so you'll need a very small ceramic or plastic alignment tool. Since it's also risky to adjust it without instruments, be cautious and note

carefully the direction you've turned it, and how far — so you can restore it to the original setting if necessary.)

Once your first channel is correctly tuned, change SW1 to position 2 and tune in the next station using the same procedure. Then tune the other channels in exactly the same way, doing all of your tuning with SW3 in the 'Tune' position, and just flicking it back to the 'Normal' position to check each setting.

With all six channels set up in this way, the last tuning step is to switch SW3 back to the 'Normal' position, and leave it there.

Sound alignment

Now you should be ready to align the sound coils. This is not unduly difficult, and you should be able to do it quite quickly. First of all, turn SW1 to any of your local channels. Then turn up the volume; probably most of what you'll hear will be noise, but there will probably be a small amount of programme sound.

Now, using a suitable plastic or ceramic alignment tool, slowly adjust the tuning slug of 36MHz coil L2 in one direction and then the other, until you hear the noise level reducing, and the sound signal increasing. Whichever direction achieves this is the correct direction to keep turning, until you reach the optimum setting — where the noise will pass through a broad null, and the signal through a broad peak. (You may need turn back the volume control as you proceed, to prevent overloading your amplifier or your ears.)

When this optimum setting is found, L2 is correctly set and you can turn your attention to L3, the 5.50MHz coil. Here again, it's basically just a matter of adjusting the slug in L3 until you get the loudest undistorted sound, and the minimum background noise. As the exact optimum setting can be a little tricky to find, try deliberately turning the slug to either side, until you hear the noise increase again each time. Then note how far you've turned between the two 'noise just audible' settings, and split the difference to locate the optimum point.

With L2 and L3 both set up, your final step is to set up L4. This is done in virtually the same way as L3, but with mode switch SW2 set to the 'Bilingual2' position so you're listening this time to the signal from the 5.74MHz subcarrier. It will also be necessary to make sure you're tuned to a stereo station; otherwise there won't *be* any 5.74MHz sound signal to peak up on!

Other than that, it's again just a matter of adjusting the slug in L4 until you get the loudest undistorted sound, and the minimum background noise.

Turning mode switch SW2 now to the 'Stereo' position should at last result in full stereo sound to emerge from your hifi system speakers, and your receiver is very close to finished. The only remaining adjustment is the setting for RV9, the stereo matrix balancing pot.

This is not a critical adjustment, and in many cases the initial 'halfway' setting of this pot is likely to be fine. However if you want to set it up accurately, the easiest way is to monitor the 'L-R' audio output with one channel of your amplifier, while viewing a programme with an essentially 'front centre' mono source, in a relatively 'dead' environment — someone giving the news, for example. The idea is to adjust RV9 for *minimum* output from the L-R channel.

With this adjustment done, your Stereo TV Sound Receiver should be complete. All that remains is to screw the top on the case, and settle down to enjoy yourself watching TV with the added dimension of stereo sound.

Of course if you wish to take advantage of the Receiver's L-R, L+R and subwoofer outputs, for a low cost but quite impressive 'surround sound' effect, so much the better. You'll just need a few more amplifier channels, to handle the extra signals. I can recommend Rob Evans' little Shoestring Amplifier for this — it fills the bill very nicely. ❖

Alternative IF module, SAW filter

After our first article describing this project had been printed, we learned that the Hwa Lin HL-PIF-36MC05 IF module specified may have been discontinued by the manufacturer. However an alternative module is available: the HL-PIF-38MC02, which appears to differ mainly in that its video IF is 38.9MHz, rather than 36.875MHz.

Although we have not had the opportunity to test this alternative IF module, it should be possible to use it providing the SAW filter used in the receiver's sound channel is also changed, to a Murata SAF38.9MVB70Z. As the type number suggests, this filter is again designed for 38.9MHz, and is in fact specifically designed for quasi-split sound.

As far as we can see, no other component changes should be needed to use these alternative parts. However in view of the move in intermediate frequency, you will probably need to adjust the IF output tuning slug in the tuner module, to achieve optimum picture and sound quality. Take care, though; adjusting this slug without instruments is risky, so make a careful note of the direction you turn it (anticlockwise would be correct), and how far — so you can restore it if you strike trouble.

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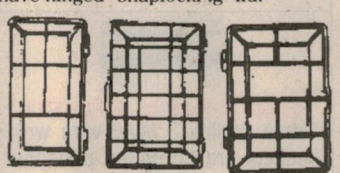

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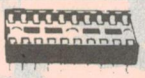

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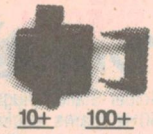

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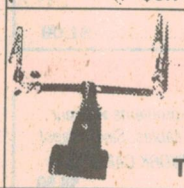

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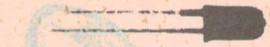

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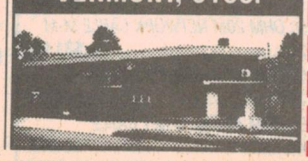

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Circuit & Design Ideas

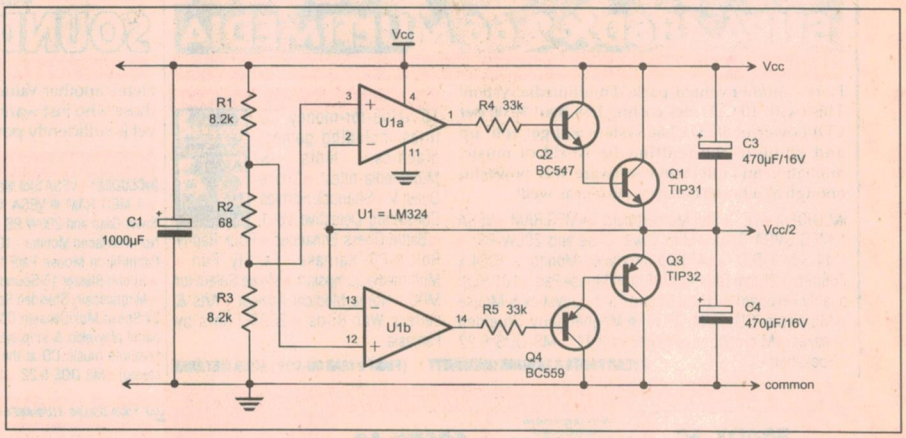
Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide further information.

Dual polarity supply

I recently needed a dual-rail power supply for a low power circuit in a car. I decided not to use an inverting switch-mode power supply as it was far too complex and expensive for the task.

The final design that I came up with was a special type of series regulator that is able to both source and sink current, while providing an output that is exactly halfway between the power supply rails.

The circuit is relatively simple. A voltage divider is used to provide two voltages, each slightly different to the midpoint voltage (Vcc/2).



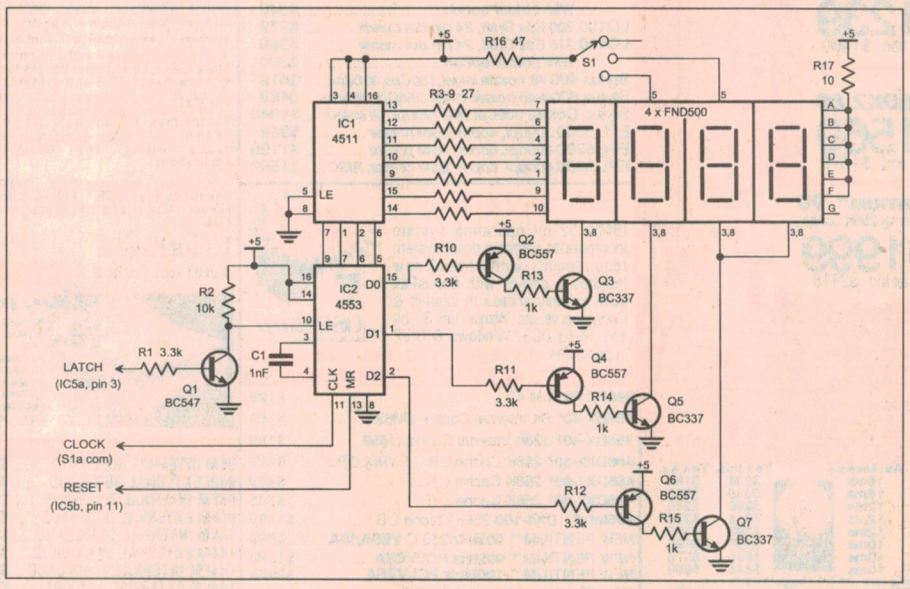
These voltages are fed to the non-inverting inputs of two op-amps, which are arranged in a voltage follower configuration. This means that the emitter voltage of the power transistors (Q1 and Q3) will be virtually the same as the voltage on the non-inverting input of the op-amp they are connected to.

Therefore, if the link between the emitter of Q1 and the emitter of Q3 was cut, there would be a voltage slightly higher than Vcc/2 at the emitter of Q3, with the emitter voltage of Q1 slightly lower. This has been done to prevent the power transistors forming a possible short-circuit between the supply rails, as for these emitter voltages, the polarity of the transistors will prevent any current flowing.

This circuit has many applications, such as a basic dual-rail laboratory power supply. The power rating of the circuit can be increased by using 2N3055/MJ2955 transistors rather than the type shown.

A fuse should be connected in series with the circuit if it is being powered from a car battery or an unprotected DC power supply. The maximum supply voltage is 30V.

Peter Tree,
Palm Beach, Qld. **$40**



LED display driver

This circuit was designed to replace the 74C926 IC in the Tacho/Dwell Meter featured in *EA* October 1980. This IC now costs around $20, while the ICs in this circuit cost about $5.

The 4553 has all the counters, multiplexers, latches and BCD outputs to drive three digits.

The original circuit has four digits, but the least significant display (LSD) shows zero all the time anyway. This is achieved in the alternative circuit by connecting segments A to F of the LSD to the +5V rail, via a 10 ohm current limiting resistor, and multiplexing the display in parallel with the second display.

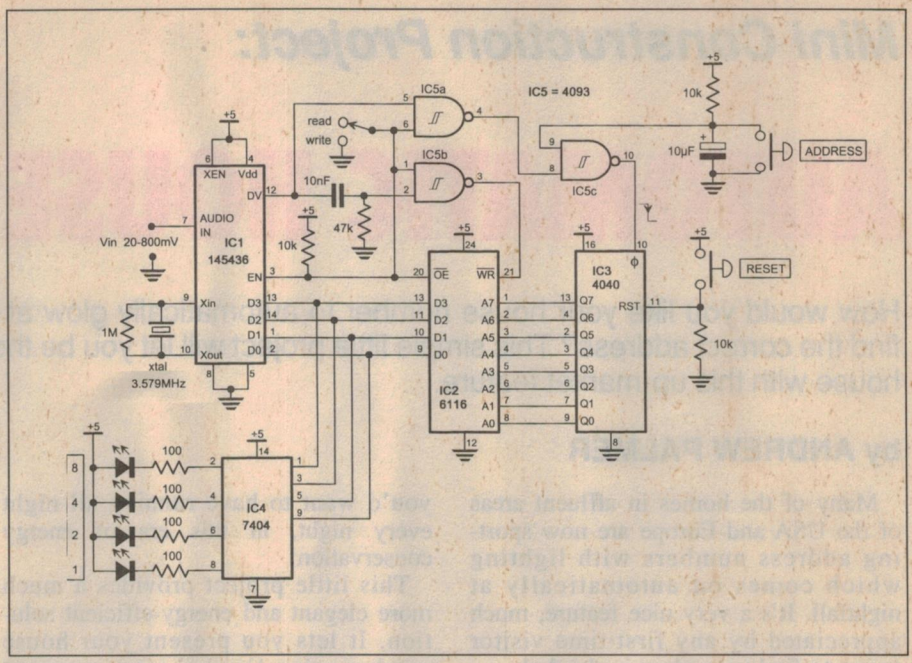
The 4553 needs a low on the latch enable line (pin 10), where the 74C926 requires a high. Transistor Q1 and its associated resistors provide the necessary inversion. The clock and reset lines don't need to be altered.

Capacitor C1 sets the multiplexing frequency. The 4511 decodes the BCD output from IC2 to the seven-segment output needed by the displays. Its output stage can drive the displays directly, via 27-ohm current limiting resistors. Each display is multiplexed by the outputs D0 to D2 of the 4553 and their associated transistors, which are connected in a Darlington arrangement.

G. Moore,
Albion Park, NSW. **$25**

If you have a great new idea for a circuit, why not let us know. Send your diagram and notes to The Editor, Electronics Australia, PO Box 199, Alexandria, NSW 2015.

DTMF decoder



This circuit will decode a string of DTMF tones and store them in memory, allowing you to index through the memory and display each of the DTMF 'digits' when you wish.

It is a hardware-only design, and is therefore less complex than the various microprocessor-based designs that have appeared in overseas electronics magazines.

IC1 is a Motorola 145436 DTMF decoder (available from Altronics), which produces a BCD weighted output for the correct tone pair it sees at its input.

As well, it produces a 'data available' (DV) level change at pin 12. Most DTMF series of tones are non-contiguous, which means each DTMF is separated by a no-signal pause (usually 60ms each), and therefore the pulsing signal at pin 12 (DV) can be used as a strobe to load the BCD digit into the 6116 RAM.

IC5 is a quad Schmitt trigger NAND gate, with IC5b and its associated RC network used to form an inverted write pulse for IC2. The 'data available' pulse is also used to increment a simple address register, via IC5a and IC5c, to IC3, a CMOS ripple counter.

The address presented to IC2 is then ready for the next DTMF decode. The output display has been kept simple and consists of a 7404 inverter (IC4) driving four LEDs. Each LED has a binary weighting (8, 4, 2 and 1) as the output is in BCD form. Otherwise, a BCD to 7-segment decoder/display driver circuit is needed.

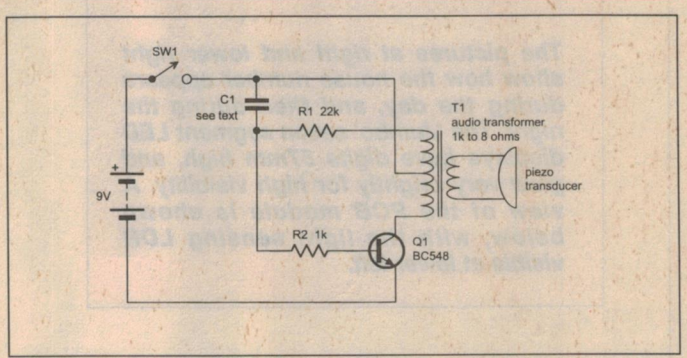
To use the device, I recommend that DTMF tones (from a scanner, etc) are first recorded on tape. Set the read/write switch to 'write' and push the reset button, then feed the audio signal from the tape into the circuit. IC1 will then decode and self-clock each sequential DTMF decode into IC2, starting at address 0000.

To read the information, press the reset button and then index through the memory using the address push-button (debounced by IC5c).

The display will show each digit in order. Note that the circuit operates from a 5V regulated DC supply.

Frank Hughes,
Mt Hawthorn, WA. **$45**

Piezo screamer



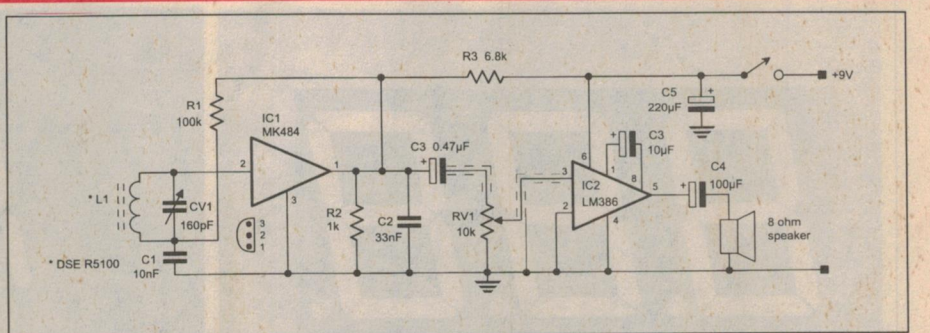
This circuit is an oscillator based around a 1k to eight ohm audio transformer, and can be built onto a piece of PCB measuring around 1.5 x 1.5cm.

It produces an intense whistle and is quite unbearable in close range. It has numerous applications, and I have used it as an indicator and an alarm.

Capacitor C1 is selected according to the required output frequency. Typical values range from 27nF to 0.22uF. A 0.1uF capacitor is very effective.

Andrew Merrick,
Northbridge, NSW. **$20**

TRF radio



This simple circuit is a TRF broadcast band radio receiver. It is cheap and easy to build and doesn't need any test gear for alignment.

The circuit uses an MK484 IC, a 10-transistor device that includes an RF amplifier, active detector and AGC. The LM386 has enough gain and output drive capability to drive an eight-ohm speaker.

It operates at full gain, achieved by the connection of C3 to pins 1 and 8. The rod antenna should be mounted away from the LM386, to prevent feedback. With no input signal, the circuit draws about 6mA from a 9V battery.

This is a simple circuit for beginners.

Robert Milne,
Moonah, Tas. **$30**

Mini Construction Project:

AUTOMATIC HOUSE NUMBER

How would you like your house number to automatically glow at night, so that visitors could easily find the correct address? This simple little project will let you be the first in your street to provide *your* house with this up-market feature.

by ANDREW PALMER

Many of the homes in affluent areas of the USA and Europe are now sporting address numbers with lighting which comes on automatically at nightfall. It's a very nice feature, much appreciated by any first-time visitor trying to find your place in the dark.

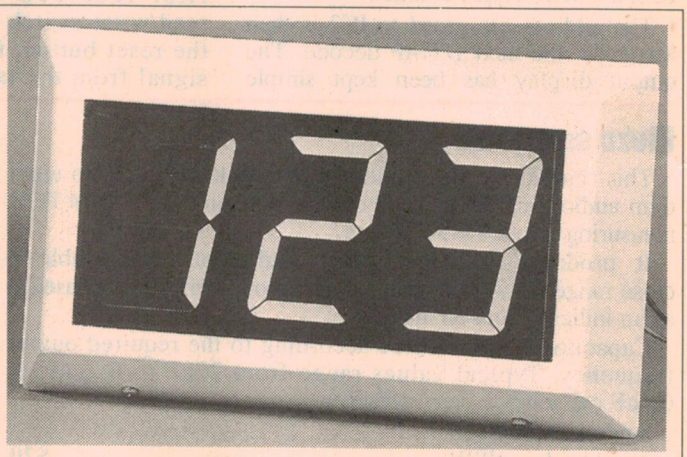
Of course you could achieve this result by using one of those light-activated switches, in conjunction with an outdoor spotlight directed at your present house number. But this would be a bit messy, and in any case most outdoor spotlights consume around 150 watts — hardly the sort of thing you'd want to have running all night every night, in this era of energy conservation!

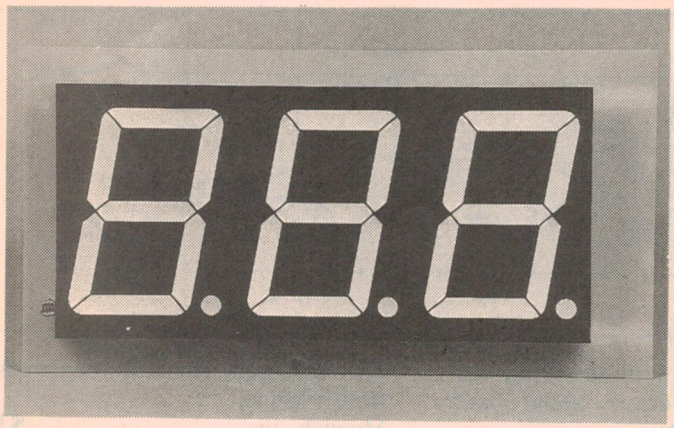
This little project provides a much more elegant and energy-efficient solution. It lets you present your house number using 'jumbo' seven-segment LED displays, with digits 57mm high — large enough to be read clearly from across the street, unless there's a very thick fog indeed...

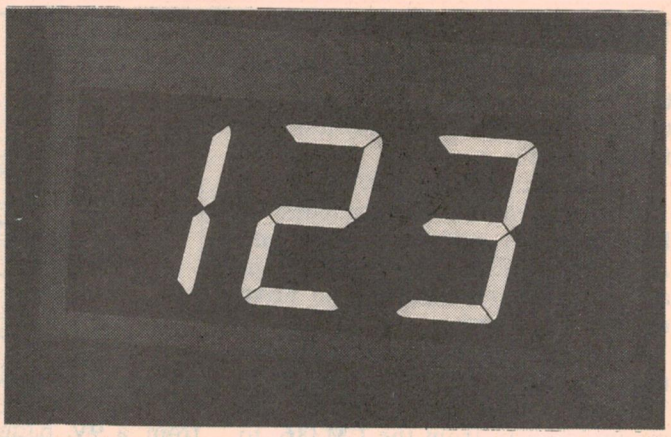
The LED displays are very bright, but at the same time they're highly efficient, so that the energy consumption is typically only a couple of watts. But the really nice thing about the project is that the LED displays are powered using a circuit controlled by a light-dependent resistor (LDR), so that the LED current and brightness is automatically varied according to the ambient lighting level.

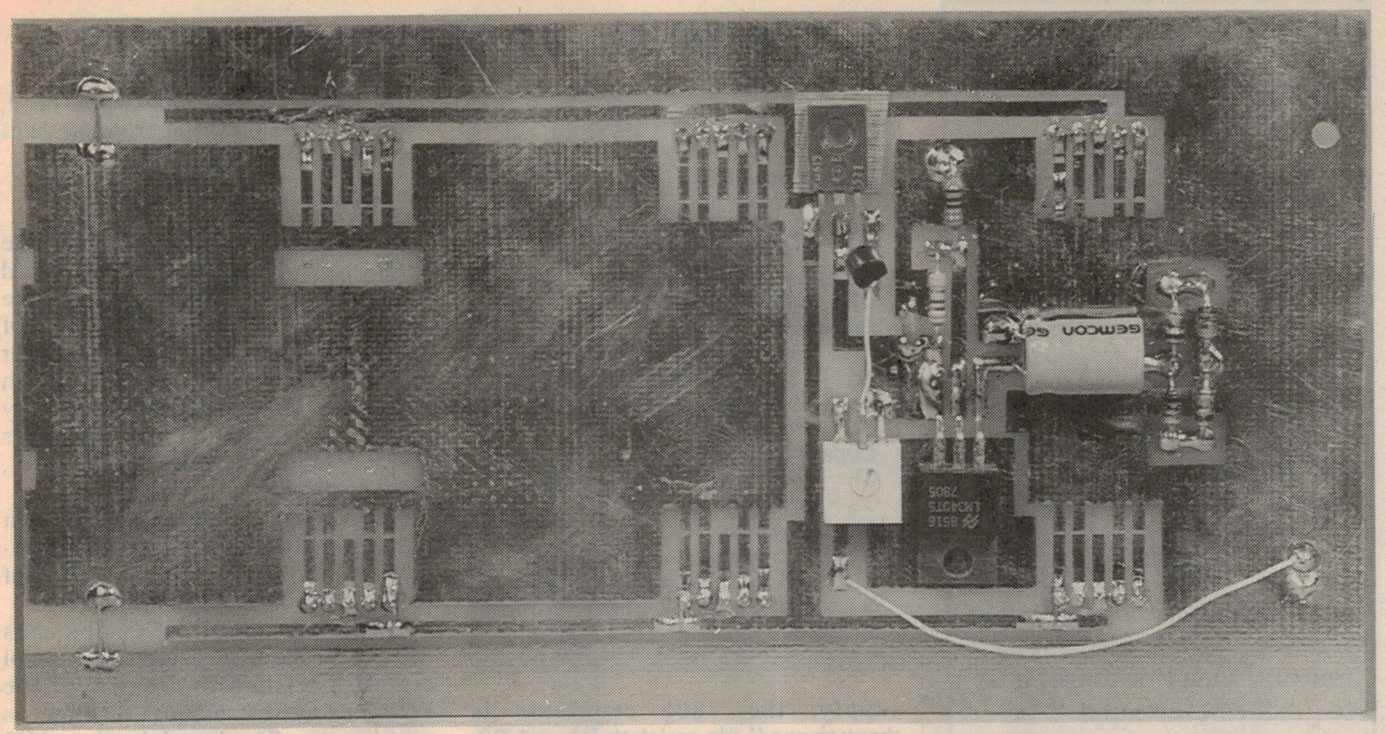
During the day, when there's no need for them to glow at all, the circuit effectively switches off the current completely. But as dusk falls and it gets darker, the LDR automatically senses this and current is gradually increased to the LEDs, so by the time it's dark they're glowing at full brightness. Then

The pictures at right and lower right show how the house number appears during the day, and then during the night. The 'Jumbo' seven segment LED displays have digits 57mm high, and glow very brightly for high visibility. A view of the PCB module is shown below, with the light sensing LDR visible at lower left.









This view of the rear of the display PCB shows how the small number of components used in the power supply and current control circuit are mounted on the back of the board 'surface mount' fashion. The heatsink tab of the LM7805 regulator is mounted against a copper area on the board, to assist in keeping it cool.

as the new day dawns and the sun rises, the LDR quietly throttles back the current again.

In short, your house number will glow when it should, and not during the day. And it will do this automatically, without you having to lift a finger or remember to switch anything on or off.

Of course during the day, with standard seven-segment LED displays you'd normally be able to see all of the segments, so that your daytime house number would become '888'. However this is easily fixed, by using black paint to make the unwanted segments just as dark during the day as they are at night.

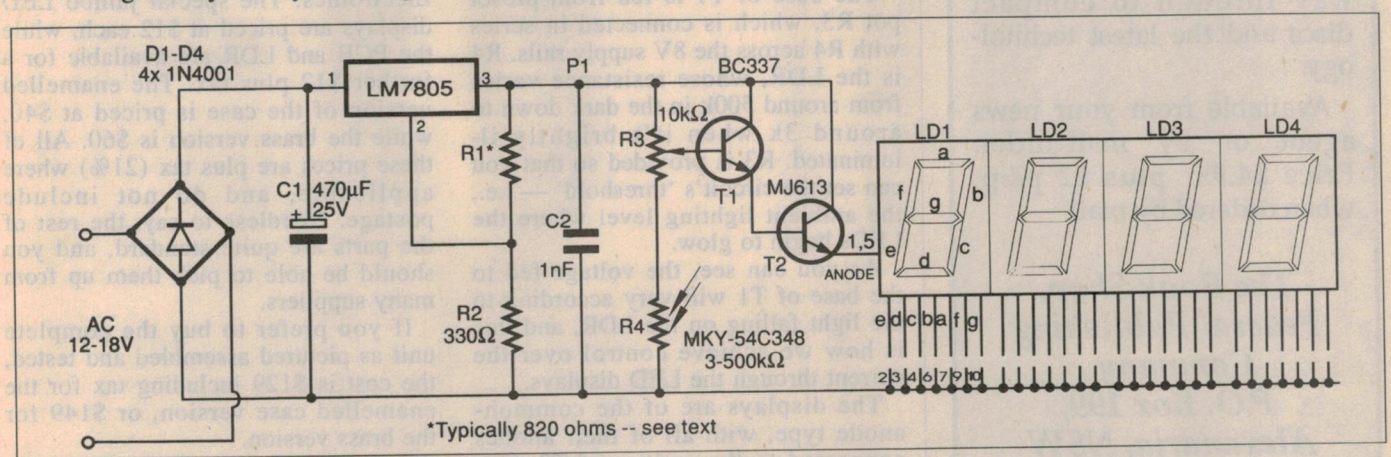
Before we look at the circuit, I should note that this project has been developed by Paris Radio Electronics, who can supply all of the special parts it involves — the jumbo LED displays, the LDR, the PC board and very nice metal-and-glass case shown in the main photos. For those who don't have the time to build up their own unit, PRE can also supply it to order fully assembled at tested. More about these options later.

The circuit

As you can see from the schematic, the circuit for the automatic house number unit is quite straightforward. The power to run the LEDs normally derived from an AC 'plug pack' supply, delivering between 12V and 18V AC. (In areas away from an AC supply, you could use a 12V battery instead.)

The incoming supply is first passed through a full-wave bridge rectifier formed by diodes D1-4, with capacitor C1 used for smoothing the resulting DC. An LM7805 three-terminal regulator is then used to produce a regulated voltage P1 of around 8V DC, for the LED display control transistors T1 and T2.

Note that to provide the regulated 8V



Incoming unregulated AC from a plug pack or DC from a battery is used to produce a regulated eight volt supply by the LM7805 regulator, in conjunction with resistors R1 and R2. Transistors T1 and T2 are then used to control the current fed to the LED displays, with LDR R4 controlling the input voltage to transistor T1.

Automatic House Numbers

PARTS LIST

Semiconductors

D1-4	1N4001 power diode
T1	BC337 NPN transistor
T2	MJ613 NPN power transistor
LD1-3	Jumbo 7-segment LED display
U1	LM7805 5V regulator, TO-220

Resistors

R1	820 ohms 0.25W 1% metal film
R2	330 ohms 0.25W 1% metal film
R3	10k linear preset pot
R4	MKY-54C348 LDR

Capacitors

C1	470uF 16VW RB electrolytic
C2	1nF ceramic

Miscellaneous

PCB, 170 x 90mm (see text); 12V AC/300mA plug pack supply; enamel or brass finished case with glass window, as desired.

supply, the 7805 regulator is 'bootstrapped' via resistors R1 and R2. The value of R1 can be varied over a small range to adjust the maximum current (and hence brightness) fed to the LED displays.

For most users, the best value for R1 will be 820 ohms as this results in a regulated voltage P1 of around 8.25V. Changing R1 to 750 ohms will give a voltage of around 8.4V and higher brightness, while increasing it to 1k will reduce the voltage to around 7.85V and reduce the maximum brightness.

T1 and T2 are connected as a Darlington pair, used here as a high current-gain emitter follower. T1 is a BC337 small-signal NPN device, while T2 is an MJ613 plastic package power NPN.

The base of T1 is fed from preset pot R3, which is connected in series with R4 across the 8V supply rails. R4 is the LDR, whose resistance varies from around 500k in the dark down to around 3k when it's brightly illuminated. R3 is provided so that you can set the circuit's 'threshold' — i.e., the ambient lighting level where the LEDs begin to glow.

As you can see, the voltage fed to the base of T1 will vary according to the light falling on the LDR, and this is how we achieve control over the current through the LED displays.

The displays are of the common-anode type, with all of their anodes connected to the emitter of T2. The PCB has all segment cathodes for each of the LED displays brought out to pads, making it easy to 'program' each display for the digits you need, merely by linking the appropriate pads to the negative supply rail.

Construction

As you can see from the photos, the complete unit is based on a PC board measuring 170 x 90mm. Three of the jumbo LED displays fit on the front of the board, along with the LDR (at lower front). Hence the unit as shown can cope with any simple numeral-only house number from '1' to '999', plus many composite numbers like '27a', '42b' or '83c'.

For those who must have a four-digit or three-digit-plus-letter number, we understand that a four-display version of the PCB will be available from PRE.

The small number of components needed for the LED brightness control circuit are fitted to the rear of the PCB in 'surface mount' fashion, as you can see. The heatsink tabs of T2 and the 7805 regulator are simply laid in contact with the PCB copper, and this provides adequate heatsinking.

It all makes a compact and tidy assembly, and as you can see PRE has available a very nice matching case, for fitting to a suitable position on your front porch or wherever.

The case is available in two versions, by the way — one finished in white powder-coat enamel and the other in brass. Both versions are solidly made and include a glass protective window for the displays.

Getting the parts

As noted earlier, all of the key components needed for this project are available from Paris Radio Electronics. The special jumbo LED displays are priced at $12 each, while the PCB and LDR are available for a further $12 plus tax. The enamelled version of the case is priced at $40, while the brass version is $60. All of these prices are plus tax (21%) where applicable, and do not include postage. Needless to say, the rest of the parts are quite standard, and you should be able to pick them up from many suppliers.

If you prefer to buy the complete unit as pictured assembled and tested, the cost is $129 including tax for the enamelled case version, or $149 for the brass version.

For further information, contact Paris Radio Electronics at 161 Bunnerong Road, Kingsford 2032; phone (02) 344 9111. ❖

SHORTWAVE LISTENING

with Arthur Cushen, MBE

More interesting summer listening

This month we cover many more countries which have broadcasts in English, and beam their transmissions to Australia and New Zealand.

BULGARIA: Radio Bulgaria, Sofia broadcasts to Australia at 1000 - 1100 on 12,040kHz and to North America at 0500 - 0600 on 7335 and 9700kHz. These are the best received transmissions in this area, and the use of 7335kHz is interesting because that is close to Canadian Time Signal Station CHU, on 7333kHz.

CANADA: Radio Canada International, Montreal broadcasts at 0200 - 0259 on 6120, 9755kHz; at 0300 - 0359 on 9755; at 0400 - 0429 on 9505, 9670kHz; at 0600 - 0629 Monday - Friday on 6050, 6150, 9760, 11,905kHz; and at 2100 - 2220 on 11,945, 13,650, 13,690, 15,140, 15,325 and 17,820kHz.

CUBA: Radio Havana, Cuba has announced a new English schedule, at 2100 - 2200UTC to Europe on 11,720kHz; to Eastern North America at 0100 - 0500 on 6000kHz; and to Western America at 0500 - 0700 on 9820kHz. There is an SSB test on 9835kHz using a power of 30kW and it is in parallel with the broadcast on 9820kHz.

ECUADOR: HCJB, Quito has broadcasts to the South Pacific at 0700 - 1100 on 6135kHz, replacing 11,925 and 9745kHz; to North America on 12,005 at 0400; and at 0430 the station drops 9745 but continues on 12,005kHz as well as SSB on 21,455 and 17,490kHz.

FRANCE: Radio France International broadcasts to Oceania at 1400 - 1500 on 7110, 12,030 and 15,405kHz; and to North America at 1200 - 1300 on 11,615, 13,625, 15,365, 15,515, 15,530 and 17,575kHz. The station broadcasts in French to Australia at 1030 - 1130 on 11,700kHz.

HUNGARY: Radio Budapest has broadcasts at 2000 - 2030 and 2200 - 2230 on 3995, 6110 and 7220kHz; at 0200 - 0230 on 6025, 7220, 9835kHz; and at 0330 - 0400 on 5970, 7220 and 9835kHz.

ISRAEL: Transmissions have been retimed and the best two broadcasts in this area are at 0500 - 0515 on 7465, 9435, 17,545kHz; and at 2000 - 2030 on 7405, 7465, 9435, 11,603 and 17,575kHz.

KOREA: Radio Korea is received in English at 1130 - 1200UTC on 9650kHz, the transmissions being relayed by Radio Canada International. Radio Korea also broadcasts in English at 0100 - 0200 on 7500 and 15,575kHz; and at 2100 - 2200 on 15,575kHz.

PALAU: Palau has formally proclaimed independence and was the last United Nations Trust Territory in the Pacific. Palau will continue to receive American aid and it has a Treaty to retain the base for 50 years. The station can be heard on shortwave when KHBN is heard at 9830kHz at 0900UTC, with English announcements and programmes in Chinese.

RUSSIA: Now known as the Voice of Russia World Service, Moscow, the schedule for listeners in Australia and New Zealand is extensive but the main times of listening are as follows: at 0600 - 0700 on 15,320, 17,610, 21,790kHz; at 0900 - 1000 on 9550, 9800, 11,675, 11,710kHz; also at 1100 - 1200, 2030 - 2100UTC on 9780 and 12,015kHz.

SPAIN: Radio Exterior de Espana, Madrid is well received in the transmission at 0500 - 0600UTC on 9540kHz. The broadcasts include on Sunday a programme called Distant Listening, of special interest to shortwave enthusiasts.

SWEDEN: Radio Sweden, Stockholm has a service in English to Asia and the Pacific at 1230 - 1300 on 1,3775, 15,120 and 15,240kHz; at 2300 - 2400 on 11,910 and from 0130 - 0200 on 9895 and 11,695kHz.

SWITZERLAND: Swiss Radio International, Berne has English broadcasts to the Pacific at 0900 - 0930 on 9885kHz, relayed via French Guyana. The station also uses 13,685 and 17,515kHz, which are direct transmissions from Switzerland.

THAILAND: Radio Thailand World Service has dropped 9700kHz and 1900 - 2000UTC transmission in English is now on 11,855 and 2030 - 2045 to Australia and New Zealand is now on 11,835kHz.

TURKEY: Ankara has broadcasts in English at 0300 - 0400 on 9445kHz; also at 2000 - 2100 on 9400; at 2200 - 2300 on 11,710 to Europe; to the Middle East at 2200 - 2300 on 7185; and to South West Asia at 1230 - 1300 on 9675kHz.

USA: WEWN, Birmingham, Alabama has an extensive schedule but the best times for reception in the South Pacific are at 0400 on 7425; at 0600 on 7425; and at 0800 on 7425 and 9350kHz.

WINB, PO Box 88, Red Lion, PA is using 12,160kHz up to its 2100 sign off. It then moves to 11,915kHz. WINB is now operated by new owners and has made some frequency changes; in the past for many years they operated on the same channel, 15,185kHz.

WWCR: Nashville, Tenn., is using a frequency near the 60 metre tropical band. They are on 5065kHz and have been noted at 0600UTC; this is the first time that a US station has moved to such a low frequency.

Shortwave listeners have been concerned that this may be a trend with the falling sunspots, to move into a band which has been traditionally only used by stations in the tropics. WWCR is also using 12,160kHz from 2100UTC. They open on the frequency at WINB closes.

YUGOSLAVIA: Radio Yugoslavia, Belgrade has been noted in the European Service at 1930 - 2000 in English on 9720kHz with a fair signal, while the other frequency of 6100 is blocked by Deutsche Welle. The station has made some changes to its English broadcasts: to Australia at 1300 - 1400 on 11,865kHz; at 1930 - 2000 to Europe-Africa on 6100, 9720kHz; at 2200 - 2230 to Europe on 6100, 6185kHz; to North America (except Sunday) at 0100 - 0130 on 6195 and 0200 - 0230UTC on 6190kHz.

France's new system

Radio France International has inaugurated the first of a new generation of shortwave transmitters and antennas, which according to BBC Worldwide are of unconventional design.

Most shortwave broadcasting sites have a large central building, which houses the transmitters and with the antennas radiating from it. This has been the practice since the BBC's Empire Service transmitting station was built at Daventry.

RFI's new 500kW transmitters at Allouis-Issodun in central France are located in an underground bunker. Instead of feeding the signal out to a large, complicated antenna farm shared with other transmitters, each has its own rotatable curtain antenna array immediately above the bunker.

This allows for a little more flexibility in scheduling, because each transmitter has its own dedicated antenna. Frequency engineers no longer have to plan which transmitter can be switched to which aerial throughout the day and night. Because the antenna rotates, it can be aligned to beam programmes in any direction in any time.

Voice of Peace

The Voice of Peace is a new transmission from Addis Ababa, Ethiopia and is operated by a group of European charitable organisations who are promoting peace and reconciliation to express humanitarian concerns for the Rwandan people. The broadcast is heard opening in English at 0400UTC on 9560kHz, and is the first indication of concern through radio for the problems in Rwanda.

It is understood that the transmitter was formerly that known as the Voice of the Gospel and taken over the authorities when there was a change of Government in Ethiopia, as a propaganda outlet.

Deutsche Welle some years ago established a relay base at Kigali, the capital of Rwanda. This consists of two 250kW transmitters. The first was installed in 1968 and the second in 1989. During the height of the Rwanda fighting the transmitters were off the air, but are gradually being put back into service as electricity and communication is being restored to the area. Rwanda itself had its own internal domestic service, which was carried on shortwave, and earlier last year reception of 15,340kHz was often reported in the South Pacific. ❖

This item is contributed by Arthur Cushen, 212 Earn Street, Invercargill New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 11 hours behind Australian Eastern Daylight Time and 13 hours behind NZ Daylight Time.

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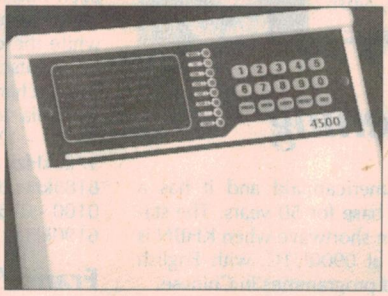

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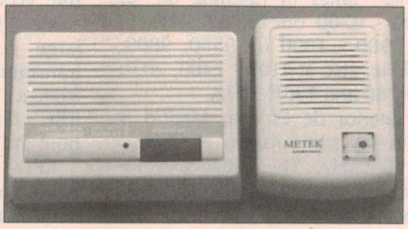

This doorphone system gives you maximum security by allowing you to talk to whoever is at the front door without opening it.
The system includes an Indoor Station and a weather proof Outdoor Annunciator Station. The visitor presses the push button on the outside unit, this activates the indoor station which sounds a pleasant "ding dong". To speak with the visitor press and hold the "operate/talk" button. For listening, release the button. The visitor station becomes hands free and incorporates an auto power switch to switch the unit off after 30 seconds. Requires one 9V battery or use a 9VDC plugpack (Cat MP-3003 9VDC 150mA $10.95). Both units are made from ABS plastic, there is a low battery warning light and the two units are connected with a 2 core cable which is supplied (20 metres).
A quality low priced product that is user friendly and works well.

Cat. AM-4320 **$32.95**

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AM / FM POCKET RADIO

NEW

This small radio has excellent tonal qualities for its size. Its AM and FM has a tuning and volume control, an earphone socket and a carry strap. It takes 2 x AA batteries (not supplied) and measures only 61(W) x 99(H) x 19(D)mm. Ideal size for pockets, bags, glovebox, etc for listening to the races, while gardening etc.

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The kit is approved by Dolby Laboratories (USA), and is the only kit currently available in the world for a Dolby Pro Logic Surround Sound Decoder.

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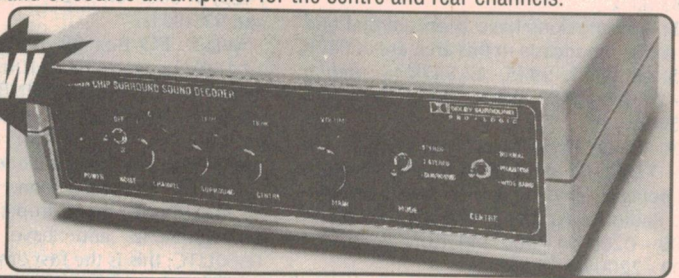

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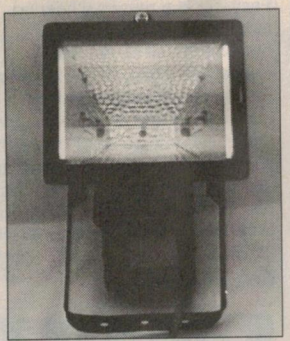

New for 1995. There are many units on the market that look similar to these, but before buying please look at the features our have that are probably not on the others, and these others are probably more expensive!! We are direct importing these, so there is no expensive middleman making his cut. Check out our price!!

Units operate on the detecetion of body heat. When the unit detects human movement within its field the floodlight switches on automatically. After the last detection of movement it will operate for a preset time, then switch off and rearm itself. Only operates after dark.

Features: •Attractive integrated design •110° viewing angle •Range 10 to 15 metres •Operates only after dark •LED walk test facility •PIR adjustable both vertically and horizontally •Complete with Tungsten halogen lamps •Adjustable sensitivity •Adjustable time on •Enclosed floodlight with plastic cover •Better than our old PAR38 because they could be hit with a hammer and broken.

Specifications: •PIR - 28 segments with 3 levels •Range at 2.5m mounting height - 15° from vertical 12 - 15 metres •Test reports for compliance to BS4533 Part 101 (EN60598-1) •240VAC operation •Dimensions: 150 watt: 120(W) x 130(D) x 160(H)mm, 500 watt: (190(W) x 140(D) x 220(H)mm Total size

NEW

Spare Halogen lights available

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Just like the real poker card machines in Clubs, Pubs etc.

•Bet high or low •Double up as many times as you like •Bet from $1 to $100 / bet

BLACKJACK - JUST LIKE THE REAL CASINO'S

•Can split •Can have insurance like the dealer •If you have never played Blackjack this game will teach you how to play. For example - "word" prompts appear when other options are available (Split, Double your bet and insurance to the gambler).

Bet from $1 to $100 per bet.

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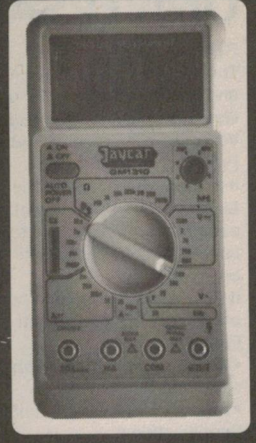

With: •transistor test •capacitance •auto power off •large display •audible continuity •diode test •20 amp. See our 1994 catalogue for full details.

Cat. QM-1310 Normally $79.95

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SAVE $20

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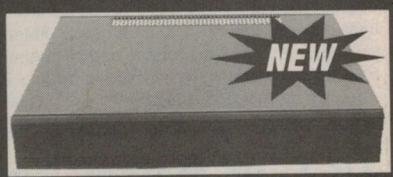

NEW

Another surplus stock purchase with a limited number available. This case is real quality and was used for a satellite receiver, and were left over when the production ended. Its made with 1.5mm steel, which has been black anodised. The chassis base includes a sub front panel and a separate front panel is also supplied. There are two rectangular holes, which were used for LED displays. They measure 17(W) x 19(H)mm and 30(W) x 19(H)mm. There are two round holes on the right - dia 5.5mm. There is a piece of perspex also supplied which neatly fits in the front panel slots to cover the LED display holes. Perspex size is 340(W) x 25(H)mm.

It is vented at the top rear, bottom rear and underneath the front panel where the case is chamfered. The internal height for most of the case except near the sides is 76mm. Width is 430mm and depth is 345mm. There is no rear panel, you could use one of our 88mm rack panels for this, we have non conforming panels (Cat HB-5422 only $7)

With the 88mm panel mounted on the rear, the box could be turned around and the rear becomes the front. The uses are endless. You could mount our new Dolby Pro Logic kits in the case for a really professional finish.

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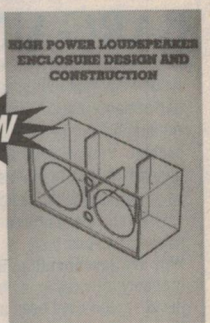

NEW

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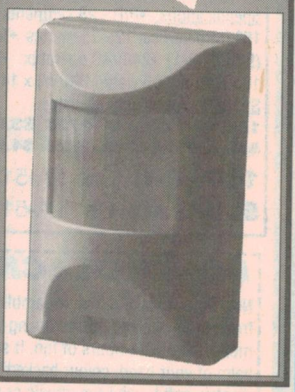

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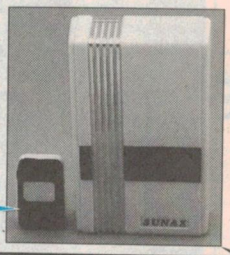

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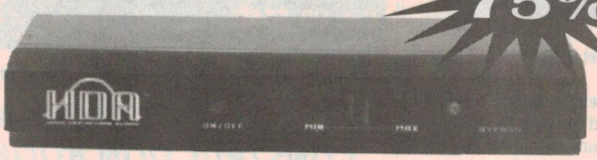

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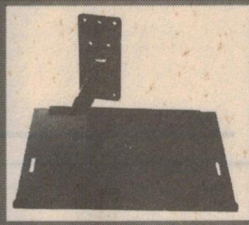

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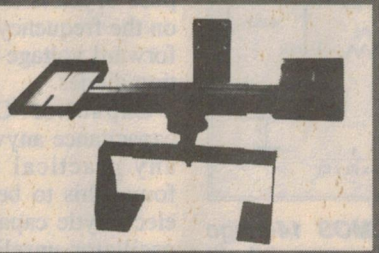

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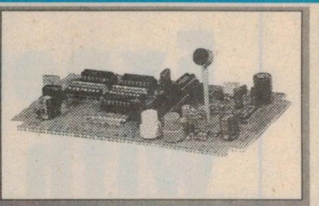

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Experimenting with Electronics

by PETER PHILLIPS

Playing games with the 4060

For a change, this month we present a range of electronic game circuits that are fun to play with, yet cheap and simple to build. They're based on a readily-available CMOS chip, the 4060.

The inspiration for this month's topic comes from the US magazine *Popular Electronics*, and three of our circuits are similar in concept (although differing considerably in detail) to those published in *PE* for September 1994, in the section called 'Circuit Circus'.

We're describing here four simple and easy-to-build games circuits, including one you may not have seen before, at least in an electronic version. The circuits can all be built on a prototyping board, but you might want to get more serious and build them on strip-board and mount them in a plastic box.

You might also think of ways of improving or expanding the games. For example, in some games you can add more sections to get another variable (more of a challenge), or duplicate the entire circuit for more players.

The read-out in each game is simply a number of LEDs, and the way they're arranged can make a game more intuitive and lifelike. This is another reason to build the games into a box, as the LEDs can then be arranged to suit. You'll get the idea as we go along.

The main component in all our circuits is the 4060, a CMOS IC described as a 14-stage ripple-carry binary counter/divider and oscillator. To kick off, here's a short introduction to this inexpensive but versatile IC.

The 4060

The 4060 counter, shown in Fig.1, has 14 internal counter stages, but only 10 of the 14 have accessible outputs. As the pin-out diagram shows, the first three stages (Q0 to Q2), and stage Q10 are not wired to external pins. The lowest accessible division from the counter is therefore 16, from output Q3, and the highest is 16384, from Q13.

The count sequence is in binary, unlike the 4017 counter (used in *PE's* games circuits) which is a Johnson, or ring counter.

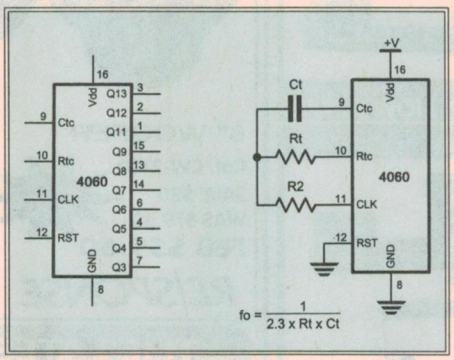


Fig.1: The 4060 is a CMOS 14-stage binary counter with its own inbuilt oscillator. The basic RC oscillator circuit is shown here. The equation for the clock frequency applies only if R2 is much higher than Rt.

This means the count sequence from the 4060 is binary, rather than decimal as with the 4017. However, for our circuits, a binary sequence is more useful.

Perhaps the main virtue of the 4060 is its inbuilt clock oscillator. The basic oscillator connection is also shown in Fig.1, where you can see that three external components are all that's needed to complete the clock circuit. The equation shown with the circuit is approximate and applies only if Rt is much lower in value than R2. The purpose of R2 is to minimise the influence on the frequency of the oscillator, of the forward voltage across the input protection diodes.

Capacitor Ct is specified as a capacitance anywhere from 100pF up to any practical value. However I've found this to be somewhat hopeful, as electrolytic capacitors tend to make the oscillator unreliable, particularly with high values for Rt and R2.

The minimum specified value of Rt is 10k, and its maximum is 1M. I've found the oscillator will function reliably with much higher values, certainly up to 5.6M, with a 10M resistor for R2. However, the equation for frequency is no longer accurate with these values.

The counter has an active-high reset terminal (pin 12), so this pin is grounded for all our circuits. Like most CMOS digital ICs, the 4060 can operate from a supply voltage ranging from around 3.5V to 15V. Our circuits are designed for a 12V DC supply, but can easily be adapted to different voltages by changing the value of the LED current-limiting resistor(s).

For instance, to make the games portable, run them from a 9V battery and use a 680 ohm resistor for the current-limiting resistors, rather than the specified 1k.

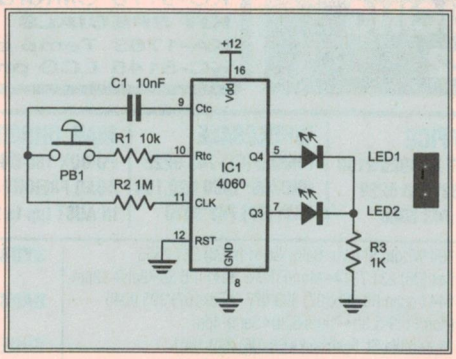


Fig.2: This simple decision maker circuit is also the electronic equivalent to Two-up. Press the button and one of four possible displays will result, just as with two coins.

Two-up

This very Australian game is our first entry, mainly because it's also the simplest. The circuit is in Fig.2. The clock frequency is around 3.5kHz, set by R1 and C1.

When the button is pressed, the clock oscillator circuit is completed and the counter is cycled through its sequence,

so fast that the LEDs appear to be on all the time.

When the button is released, the oscillator stops, leaving the counter set to a random number. The two LEDs are therefore either both on, both off or left with either one on. Like throwing two pennies in the air!

To change the operating frequency, change the value of R1. A 100k resistor makes the oscillator slow enough to see the LEDs pulsing when the clock is running. For 9V operation, make R3 a 680 ohm resistor.

Dice

Called 'Craps' in the US, this is a dice rolling game, in which the winner is the first to get two sixes. In our simulation, shown in Fig.3, two counter circuits are needed, one for each die. The clock frequency is around 15kHz, faster than the previous circuit, mainly because the circuit uses higher-order outputs. A slower frequency makes these outputs change at a visible rate.

The oscillator circuit of IC1 also provides the clock signal for IC2. Notice that the clock connection for IC2 comes from pin 9 of IC1, as this pin has the lowest impedance output.

The LEDs are grouped into threes, with separate current limiting resistors per group of three. This is needed because if all six LEDs share the same current limiting resistor, their brightness falls off noticeably when more than three LEDs are on.

As before, pressing the button lets the counters race continually through their cycle. When the button is released, you are left with a random display from both counters.

To get the best effect, arrange the LEDs for each counter like the dots on a dice, as shown in Fig.3. This way, a number is simply the number of LEDs left on. Obviously each number (except 0 and 6) will occur with different LED patterns, which means getting a six (or zero) is more difficult than any other number.

A variation is to make both counters independent, with individual clock circuits and pushbuttons. This way you can 'roll' one dice until a six is obtained, then 'roll' the other until it comes up as a six.

An interesting thing you can try with Figs.2 and 3 is to use a touch pad, rather than the pushbuttons and the RC oscillator circuits. Being CMOS, the clock input of the 4060 has a very high impedance, and you'll find the counter will cycle if you touch pin 11.

Poker machine

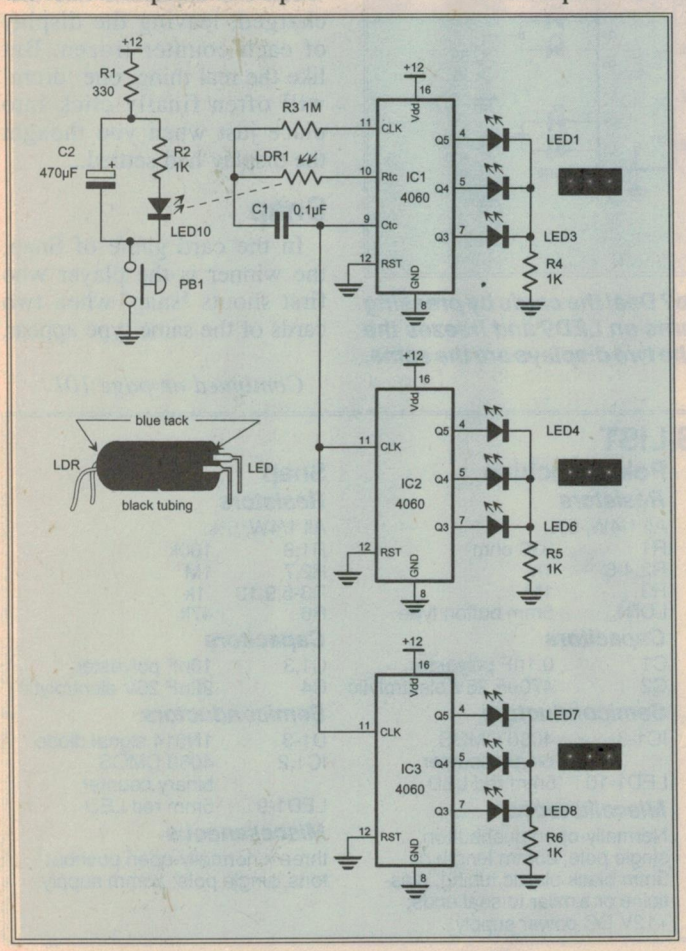
When poker machines were mechanical, you pulled a handle to make three or four drums rotate. These days you simply press a button and watch a computer screen.

Our poker machine simulation features a mechanical 'feel', in which each 'drum' (or counter display) runs at full speed until you release the button, after which the displays change at an ever-slower rate until they become stationary. You win if the three displays are all the same.

The circuit, shown in Fig.4, has three 4060s, each with outputs Q3-5 connected to three LEDs. If you want to make the odds more difficult, add another LED to output Q6 (pin 6). Arrange the LEDs as shown.

The oscillator of IC1 drives the other two counter ICs. Add another stage like IC2 or IC3 for a 'four-wheeler' machine. The oscillator circuit is identical to the previous circuits, except that a light dependent resistor (LDR) is now the timing resistor.

To get the effect of numbers changing more slowly and eventually grinding to



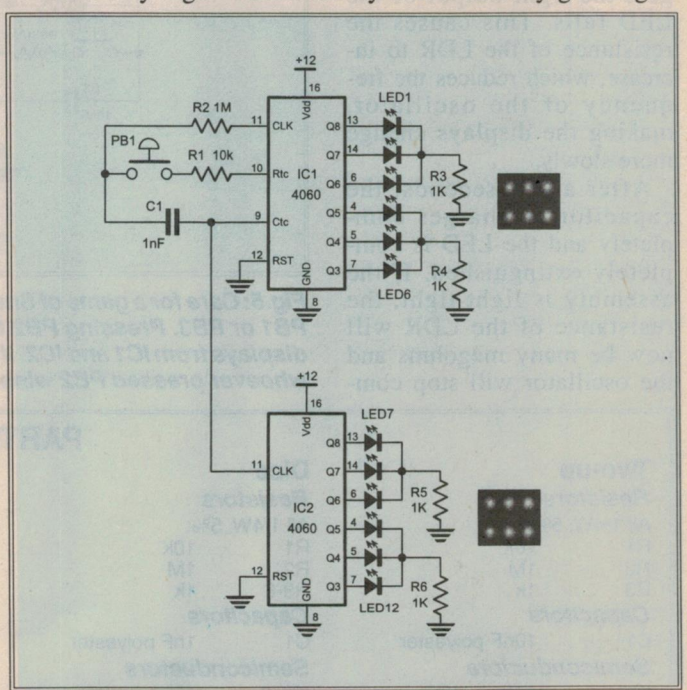


Fig.3 (above): Roll the dice! If the LEDs are arranged in groups of six, you'll find this game much easier to play.

Fig.4 (left): This electronic poker machine circuit has a mechanical 'feel'. When the button is pressed and released, the displays change ever more slowly before reaching their final value. The construction of the LED-LDR optocoupler is shown here as well.

a halt means that the counter clock frequency must run at full speed while the button is pressed, then gradually slow down and stop after the button is released. This is not as easy to do as it might sound, especially if you want to keep the circuit simple.

To achieve this here, I've resorted to a basic technique in which an LDR is encased with a LED. Providing the enclosure is light-tight, the resistance of the LDR will depend entirely on the light output of the LED.

In our circuit, when PB1 is pressed, current flows through R1, R2 and the LED. The LED glows at its maximum brilliance, and the LDR resistance drops to a few thousand ohms. As well, capacitor C2 charges via R1.

When the button is released, the capacitor discharges through the LED, via R2, keeping the LED lit for a time. As the capacitor discharges, the light output of the LED falls. This causes the resistance of the LDR to increase, which reduces the frequency of the oscillator, making the displays change more slowly.

After a few seconds, the capacitor discharges completely and the LED is completely extinguished. If the assembly is light-tight, the resistance of the LDR will now be many megohms and the oscillator will stop completely. The displays will also freeze when the oscillator stops.

To keep the effect as life-like as possible, the circuit needs to also respond to how quickly the button is pressed. That is, we need to recreate the same feel as an old mechanical 'pokie', in which the speed at which the handle is pulled controls how fast the drums rotate. In our circuit, this effect is created by R1.

If the button is pressed for a short time, capacitor C2 won't be able to charge fully, giving a slower-changing display than if the button is held for a longer time. Simple, but effective!

The LDR-LED 'opto coupler' is very easy to build. Insert a 5mm diameter LDR into one end of a piece of black 5mm plastic tubing and a 5mm LED into the other. The LED should just touch the surface of the LDR. Then seal both ends of the tubing with plasticine or 'blu-tack' to get an absolutely light-tight assembly. Measure the resistance of the LDR to confirm that the package is properly sealed. Ideally, the LDR resistance should read infinity, or at least five or more megohms.

You should find the oscillator actually stops running when the capacitor has discharged, leaving the display of each counter frozen. But like the real thing, one 'drum' will often finally click into place just when you thought the display had settled...

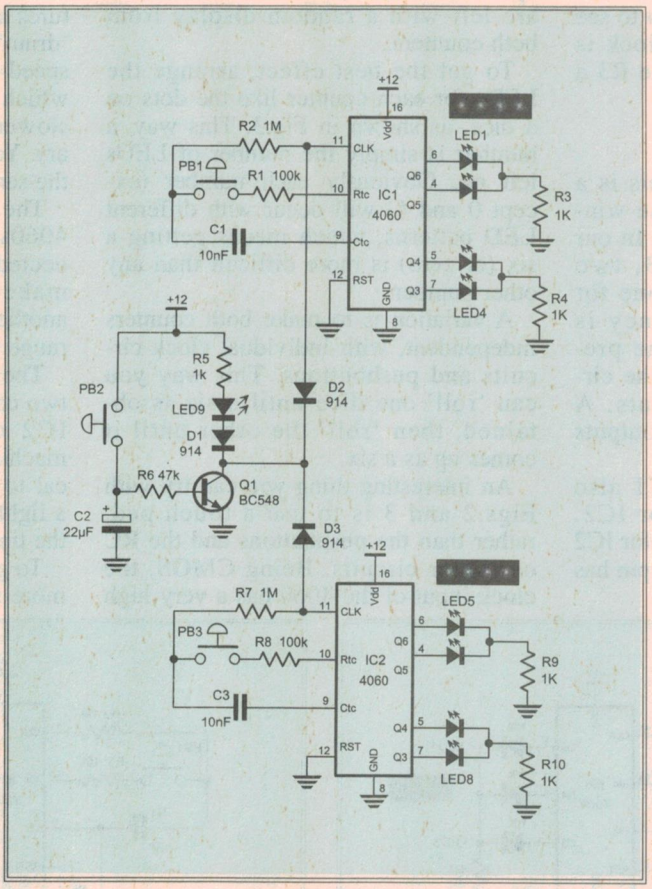


Fig.5: Care for a game of Snap? Deal the cards by pressing PB1 or PB3. Pressing PB2 turns on LED9 and freezes the displays from IC1 and IC2. If the two displays are the same, whoever pressed PB2 wins.

Snap

In the card game of Snap, the winner is the player who first shouts 'snap' when two cards of the same type appear.

Continued on page 101

PARTS LIST

Two-up

Resistors

All 1/4W, 5%:

R1	10k
R2	1M
R3	1k

Capacitors

C1	10nF polyester

Semiconductors

IC1	4060 CMOS binary counter
LED1,2	5mm red LED

Miscellaneous

Normally-open pushbutton, single pole; +12V DC power supply.

Dice

Resistors

All 1/4W, 5%:

R1	10k
R2	1M
R3-6	1k

Capacitors

C1	1nF polyester

Semiconductors

IC1,2	4060 CMOS binary counter
LED1-12	5mm red LED

Miscellaneous

Normally-open pushbutton, single pole; +12V DC power supply;

Poker Machine

Resistors

All 1/4W, 5%:

R1	330 ohm
R2,4-6	1k
R3	1M
LDR1	5mm button type

Capacitors

C1	0.1uF polyester
C2	470uF 25V electrolytic

Semiconductors

IC1-3	4060 CMOS binary counter
LED1-10	5mm red LED

Miscellaneous

Normally-open pushbutton, single pole; 25mm length of 5mm black plastic tubing, plasticine or similar to seal ends; +12V DC power supply.

Snap

Resistors

All 1/4W, 5%:

R1,8	100k
R2,7	1M
R3-5,9,10	1k
R6	47k

Capacitors

C1,3	10nF polyester
C4	22uF 25V electrolytic

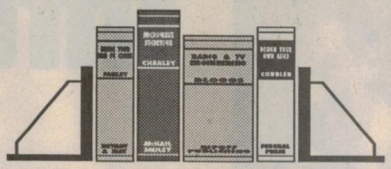
Semiconductors

D1-3	1N914 signal diode
IC1,2	4060 CMOS binary counter
LED1-9	5mm red LED

Miscellaneous

three x normally-open pushbuttons, single pole; 25mm supply.

NEW BOOKS



Circuit, device theory

ELECTRONICS THEORY AND PRACTICE, by Gerado Mesias. Butterworth-Heinemann, 1993. Soft cover, 190 x 245mm, 260 pages. ISBN 0-7506 1679-2. RRP $45.95.

While it's not likely to win awards for presentation, and despite its predictable content, this book has a number of features that make it worthwhile considering as a text for a university or TAFE level electronics engineering course.

Perhaps its main feature is the number of worked examples, which are all set on a grey background. In fact, there are so many worked examples that you can flip through up to 10 pages at a time and never see a white background. The publisher claims there are over 350 worked examples and more than 700 diagrams.

The first chapter revises the basics — Ohm's law, Kirchhoff's laws, Thevenin and Norton's theorems, superposition theory, mesh analysis and so on. Then come chapters covering transistor theory, starting with biasing, moving through transistor models, load lines and ending with cascaded systems.

Next covered is Bode plots, followed by a chapter on capacitance and high frequency transistor circuits. The last three chapters deal with operational amplifiers, quite extensively.

The book is aimed at the first year engineering student, and the writing style is surprisingly friendly for a book of this type. The author is a senior lecturer in the Department of Electronic and Electrical Engineering at DeMontfort University, and he is obviously at home with the subject matter, and aware of the need to give students lots of worked examples.

The review copy came from Butterworth-Heinemann, PO Box 345, North Ryde 2113. (P.P.)

Circuit simulation

INSIDE SPICE: OVERCOMING THE OBSTACLES OF CIRCUIT SIMULATION, by Ron Kielkowski. Published by McGraw-Hill Books, 1994. Hard covers, 235 x 155mm, 188 pages with 3.5" floppy disk. ISBN 0-07-911525-X. RRP $135.

As anyone who has tried using a SPICE package can attest, simulating a circuit is rarely as straightforward as you expect. Even after you get used to SPICE's little idiosyncracies like insisting on 'MEG' for the 10^6 unit multiplier, and sometimes refusing to run a simulation unless you add 100-megohm resistors to remove 'floating nodes' in your circuit, there are still the dreaded non-convergence failures, numeric integration failures and timestep control errors. All of which can make your simulation take twice as long as simply building up and testing your circuit on the bench — and still give you dubious results.

This new book by US simulation expert Ron Kielkowski is intended to help anyone using a SPICE simulator understand exactly how they work, why they're unfriendly at times, and how to overcome their limitations.

After explaining how SPICE was developed, he then gives an (excellent) introduction to the way it actually works. Then follow chapters on non-convergence, numeric integration, timestep control, and SPICE simulation options and their manipulation. It's all written in clear, highly readable language, and seems to me exactly what many of us have been waiting for.

The accompanying floppy disk gives free copies of a 32-bit PC simulator called RSPICE and a graphical post-processor called RGRAPH (both developed by a team led by Mr Kielkowski at RCG Research), plus circuit files for many of the examples discussed in the text. As RSPICE is SPICE2G.6 compatible, the files are also suitable for popular packages like IsSPICE and PSPICE.

In short, my impression is that this book is a 'must have' reference for anyone working with a SPICE simulator.

The review copy came from McGraw-Hill Australia, of 4 Barcoo Street, Roseville 2069. (J.R.)

Old-time radio

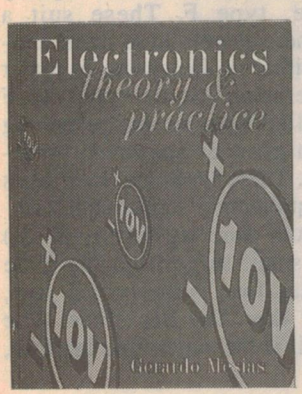
CRYSTAL SETS 'N SUCH, by R.J. Young. Published by the author, 1994. Soft covers, 221 x 140mm, 142 pages. RRP $19.95 including P&P.

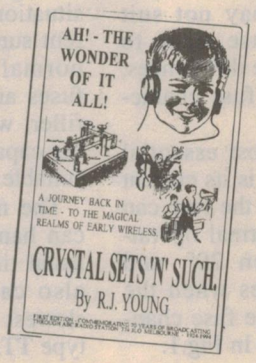
Bob Young is a vintage radio enthusiast living in Benalla, Victoria. A member and past President of the Vintage Radio Club of North-East Victoria, he has a special interest in crystal sets and has built many of them — including one that won the Club's Hellier Award, last year.

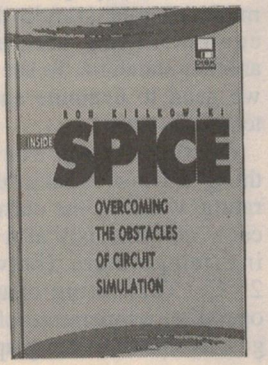
I gather that he's written this book as a 'labour of love', to help the modern reader not only understand the operation of crystal sets, but also to get a good understanding of the part they have played in the evolution of radio communications. Its cover subtitle reads 'A journey back in time — to the magical realms of early wireless', and that helps convey the effort he makes to explain the enormous appeal crystal sets had in the early days of radio, to so many people.

The text combines a nostalgic look at the origins and early development of radio, with some easy introductory material on AM radio, how crystal sets work and how to build them. This is all presented with a friendly leavening of humour, plus a variety of appropriate illustrations — including period pictures, adverts and diagrams.

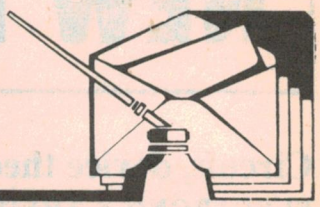
It all makes entertaining and informative reading, and would make a great gift for anyone interested in early radio. Copies are available direct from Bob Young, RMB 1561, Benalla 3673. (J.R.) ❖







Information centre



Conducted by Peter Phillips

Fuses, baluns and electrically charged rain

In the first part of this month's column I honour a promise I gave earlier, by discussing glass fuses. We then continue with reader inspired topics ranging from variable speed CD players to milligauss meters.

Some time ago we had a number of questions about fuses raised in these columns, and I promised I would research and further discuss the matter. As a result, several readers sent me material, which has been waiting on file until I had room in the column to use it. This month I'm making room, as I like to keep to my promises, even if it takes a while.

While there are dozens of different types of fuses, we only have space for those typically found in electronics, in particular the glass fuse. And I doubt if what I've found answers all the questions.

You might remember that the most contentious issue was the voltage rating of a glass fuse. Certainly there's lots said in the literature about voltage rating, but I have drawers full of glass fuses that don't have a voltage rating stamped on them, and I've seen many more in the various electronic shops. So what about these fuses? Can I assume they are rated for 240V operation. If not, what *is* their voltage rating?

From my research, it seems most glass fuses sold in Australia *are* rated at 250V, unless otherwise marked. I conclude this on the basis that it appears that these fuses are made with three voltage ratings: 250V, 125V and 32V.

Given that we don't use many 125V rated fuses in Australia, and that 32V rated fuses are generally marked as such, it seems that in the absence of a rating, you may assume 250V. Not a good situation, but when you read the section on voltage rating, I think you'll come to the same conclusion.

But certainly this short look at fuses is rather overdue, and my apologies to those readers who sent me material and have been waiting ever since to see it appear in the magazine. Naturally I'm interested in any comments you might have. Perhaps I didn't cover everything, or have got something wrong...

Fuses

Edison first patented fusing in 1880, and since then fuses have become an essential part of our technology, with different types made for the many different types of circuits they protect.

Our main interest here is the glass 'cartridge' fuse, commonly called type M205 for the 20 x 5mm size, and 3AG for the 6.3 x 32mm (1.25" x 0.25") size. Both of these fuses have the same construction: fuse wire soldered to metal endcaps that are fitted to both ends of a length of glass tubing, which encloses the fuse wire.

Standards: There are several standards for glass (or miniature) fuses, and those we are likely to see in Australia are the UL standard (Underwriters Laboratories), the IEC (Electromechanical Commission) and the CEE (International Commission on Rules for the Approval of Electrical Equipment). The UL standard is from the US, and the IEC and the CEE standards cover Europe and Asia. The problem is the standards vary quite a bit, so a fuse made to one standard may not suit equipment that uses a fuse made to another standard. To see the differences, we need to examine each fuse characteristic in turn.

Current rating: The most essential thing to know about a fuse is its current rating, which is the current the fuse can carry continuously at a normal operating temperature (between 20° and 25°C). This rating changes when the operating temperature of the fuse changes, as shown in the graphs in Fig.1.

However, depending on the standard the fuse is made to, there can be a big difference between the current rating of the fuse and the current that causes it to blow. For fuses made to the UL standard, the current rating stamped on the fuse should exceed the normal operating current of the circuit it is protecting by at least 25%.

For fuses made to the IEC standard, the current rating is about the same as the operating current of the circuit the fuse is protecting. Put another way, a circuit taking 1A can be protected by a 1A fuse made to IEC standards, or with a 1.4A fuse made to the UL standard.

Operating speed: If the electrical equipment protected by a fuse takes a considerable current surge at switch-on, the fuse needs a built-in time delay so it won't blow each time the equipment is turned on. On the other hand, equipment that uses thyristors needs very fast acting fuses, so the fuse will blow before the semiconductors. Accordingly, fuses are made with different operating speeds.

The fastest is the super quick-acting fuse, type FF, which is suitable for protecting thyristor circuits. The standard fuse (Normal Blo) is called a quick-acting fuse, type F. These suit a situation where there's little or no current surge either at switch-on, or under normal operation. Some types of F fuses are filled with an arc-quenching filler, which gives an improved breaking capacity. These types are sometimes suitable for protecting semiconductors.

The medium time lag fuse (type M) can handle small surges, but the more usual time lag fuse is the type T fuse, also called the 'Slo Blo' fuse. The slowest of all is the super time lag fuse, type TT.

Voltage rating: The rated voltage of a fuse is the maximum voltage at which the fuse can safely interrupt a short-circuit. The usual voltage ratings are 125V and 250V, although automotive fuses are generally rated at 32V.

Incidentally, a fuse can be safely used in a circuit that has a lower operating voltage. That is, you can use a 250V rated fuse in a 12V automotive system, but you should not use a fuse in a circuit where the working voltage is more than the voltage rating of the fuse.

Current breaking capacity: This is the maximum current the fuse can safely interrupt at its rated voltage. Fuses rated at 125 volts that carry the UL mark are tested with a fault current of 10,000A. UL specified 250V rated fuses can be tested differently, where 1A rated fuses must safely interrupt 35A. The test current for fuses between 1A and 3.5A is 100A; between 3.5A and 10A it's 200A, from 10A to 15A it's 750A, and those between 15A and 30A are tested with a 1500A current. The 10,000A test is also allowed for 250V rated fuses.

The IEC standards require that M205 fuses are tested at 250V. The 3AG sizes are tested at different voltages, depending on the current rating. For a current rating up to 2A, the test voltage is 250V, for current ratings from 2.5A to 4A it's 150V, and 60V is used for current ratings from 5A to 10A. High-breaking capacity fuses are tested at 1500A AC, and low-breaking capacity fuses at 35A, or 10 times their current rating, whichever is the greater.

Voltage drop: We don't usually think about the voltage drop across a fuse, but being a thermal device, a fuse not only has resistance that causes a voltage drop, it dissipates heat as a result. The voltage drop across a typical 1A M205 fuse is a few hundred millivolts, and power dissipation can be 0.5W or more.

The resistance of a fuse is usually a very small part of the total circuit resistance. However the resistance of fuses with a current rating less than 1A can be enough to cause problems in low voltage applications, where the voltage drop across the fuse is significant.

The fuse element in a glass fuse usually has a positive temperature coefficient, which means the resistance of the fuse increases with temperature. The cold resistance of a fuse is measured at a current of no more than 10% of the fuse's current rating. The hot resistance is measured at a current equal to the current rating of the fuse.

I^2t rating: Also called amperes-squared-seconds, this rating determines how much energy a fuse can pass. When multiplied by the resistance of the fuse, the energy dissipated by the fuse itself over time t can be found. A fuse with a small I^2t value passes less energy and therefore imposes less stress on the circuit being protected.

Other characteristics: There are quite a few more characteristics that describe a fuse. One of these is the cut-off characteristic, which is a rating of how fast the fuse isolates the fault current. This relates to how quickly the arc developed across the melting element is extinguished. If for example a fuse arcs for a half cycle of the 50Hz mains, energy will be passed to the circuit being protected for 10ms — which could be enough to destroy it, or at least cause damage.

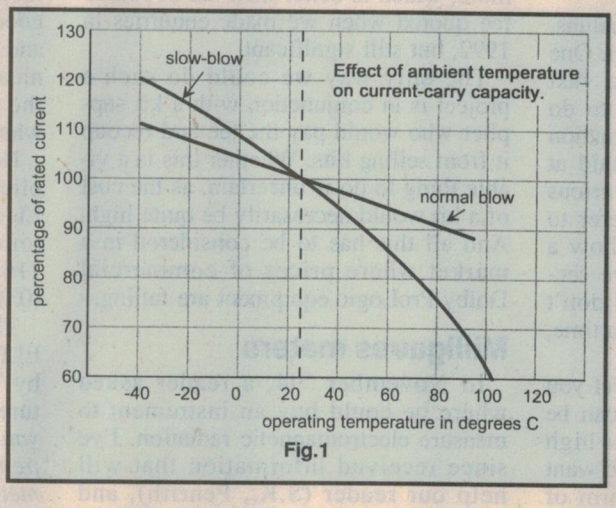


Fig.1

Although not a characteristic as such, time delay fuses have a finite lifetime, as the number of surges the fuse can survive is limited. The rate of deterioration depends on the I^2t value of the current pulses, which can explain why some fuses fail when there's no problem in the circuit they are protecting.

Conclusion: The standards relating to miniature fuses are: UL 198G, IEC Publication 127, CEE Publication 4 and a fourth from Canada, CSA C22.2. The CSA (Canadian Standards Association) standards are similar to the UL 198G standards regarding interrupting and blowing requirements, but have different specifications concerning permissible temperature rise of the fuse body.

A fuse made to the UL standards must be marked with the name or trademark of the manufacturer and its electrical current and voltage ratings. IEC or CEE specified fuses must be marked with the rated voltage, rated current in milliamperes or amperes, maker's name or trademark, and a symbol denoting the time/current (or delay) characteristic.

Acknowledgements: This information has come from various sources, including a publication from Radio Spares (Miniature Fuses, B9883) and from an article by Ray Porter (M.Sc., C.Eng., MIEE) in the January 1994 edition of the UK magazine *Television*.

Variable speed CD

We now resume our usual role, starting with a letter from a ballroom dancing teacher:

I am a ballroom dancing teacher, and also a dabbler in electronics. Dance studios are changing over to CD players for their music needs, and I'm often asked how to fit a speed control to a CD player, as I do to cassette players.

None of the technicians I know have any idea how to do this, but it is currently available on a Denon player, and I have seen it fitted to several Technics players as a modification.

The required variation is from about 10% to 20%. Perhaps you could investigate this as an article or project in your magazine. (Alan Boulton, Rothwell, Qld.)

Years ago when a friend and I brought Percy Grainger's pianistic skills back to life through a reproducing piano roll, we amazed the recording technicians by being able to slow the roll without affecting the pitch. In fact the speed of the music could be slowed almost to a standstill, with no change in pitch.

Because a piano roll is essentially a digital recording, I imagine the same to be possible with a CD player. However, I can't immediately think how best to do this. Perhaps this has been done by a reader, in which case I'd be keen to describe the details. This is about all we can do at this stage Alan, as the large range of CD players makes it rather difficult to present this idea as a project.

More on baluns

In the December '94 edition, I discussed baluns when a reader wanted to know how they can possibly work. The next letter makes a few more comments, including something I didn't know about rain.

It has always puzzled me why a conventional balun circuit (see Fig.2) is better than a toroidal 4:1 matching transformer. The grounded centre tap

on the 300 ohm side is to prevent a build-up of static charge on the dipole, but if grounding it directly prevents a problem, then grounding it via a 100k resistor should also work.

While on the subject of static build-up, I have been able to keep a 20W fluorescent tube lit continuously by connecting it between my long wire antenna for HF and ground during a rain shower (not a thunder storm). It seems every drop of rain carries a static charge which is imparted to the antenna on contact.

Incidentally, your explanation about baluns is a little confusing when you talk about 1/4-wave sections. For channel 0, a 1/4 wavelength is 1.66m, while for channel 11 its 0.34m. (David Dorling, Buderim, Qld.)

If you think I'm an expert on baluns, David, please let me disabuse you. One of my many weaknesses in the vast field of electronics is anything to do with high frequencies. The information I presented in December (as I said at the time) was researched from various texts on the subject. They all refer to the 1/4-wave section, but just how a coil of wire simulates a 1/4-wave section is something I accept, and don't question. I learnt why once upon a time, but have long since forgotten.

By the same admission, I suspect you are right in saying that a balun can be connected to ground through a high value resistor. But why you would want to do this? Perhaps as some form of protection against lightning?

I'm most intrigued by your comments about rain carrying an electric charge. In fact, from your experiment, it seems the voltage passed to your antenna and thence to the tube is quite high. Free electricity, if we could only tap into it (pardon the pun).

Surround sound delay unit

One of our most popular projects has been the Surround Sound Decoder project published in January 1992. But one of the most commonly asked questions about this project is this:

I am writing to ask if EA has since published details of a delay section for this project. Also has any consideration been given to publishing a project for a full Dolby ProLogic system? (David MacCullum, New Plymouth, NZ.)

I'm pleased to be able to report that the design for a delay unit for the Surround Sound Decoder is on its way. The cost of the ICs has since come down

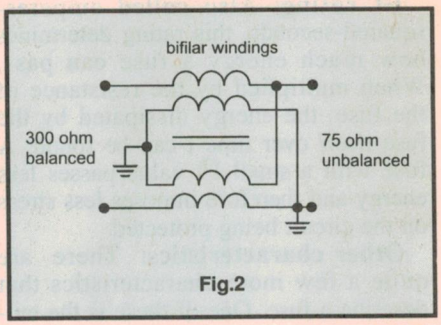


Fig.2

and such a project is now viable. It shouldn't be long!

Regarding a full Dolby ProLogic system, things are not quite so easy. The main problem is the licensing cost. Typically, the licensing cost to use Dolby ProLogic ICs is $10,000 or more, which is better than the $100,000 fee quoted when we made enquiries in 1992, but still significant.

The only way we could do such a project is in conjunction with a kit supplier who would pay the fee and recoup it from selling kits. Whether this is a viable thing to do is uncertain, as the cost of a kit would necessarily be quite high. And all this has to be considered in a market where prices of commercial Dolby ProLogic equipment are falling.

Milligauss meters

In November '94, a reader asked where he could buy an instrument to measure electromagnetic radiation. I've since received information that will help our reader (S.K., Penrith), and others who might want to do the same.

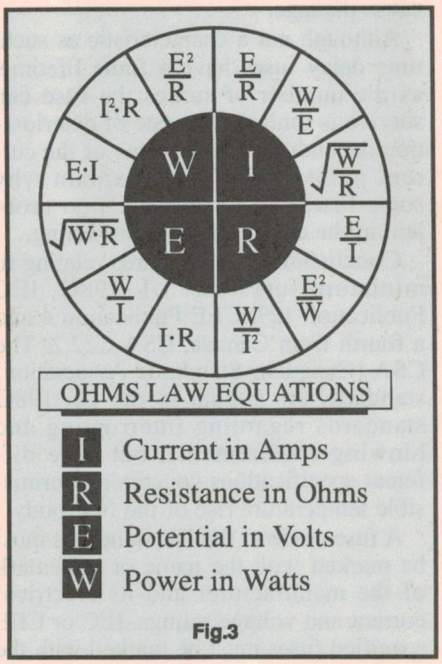


Fig.3

Incidentally, electromagnetic radiation is made up of two fields: the magnetic and the electric field. When associated with a 50Hz power source, these fields are in the extra low frequency range (ELF). Frequencies from around 2kHz to 200kHz are classified as being in the very low frequency band (VLF).

The first bit of information was a copy of an article from the March/April 1994 publication *IEEE Transactions on Industry Applications*, Vol. 30, No. 2. The title of the article is 'Electric and Magnetic Fields: Equipment and Methodology used for Obtaining Measurements', by Donald W. Zipse.

The article is written for the professional engineer, and is therefore quite technical. However, it makes many good points that will interest the layman and gives a list of suppliers of suitable measuring equipment. Unfortunately the list covers suppliers from everywhere except Australia.

However I've discovered a local supplier of milligauss meters: Consultec Electronics, 83 Flinders Street, Mentone, 3194; postal address PO Box 1161, South Melbourne, 3205. Phone (03) 585 1159; fax (03) 584 1169.

This supplier has a range of portable ELF and VLF milligauss meters, made by Teslatronics. The advertising literature for the instruments says: *Whether you are a professional who needs a dependable hand-held magnetic field meter, or simply a concerned individual who wants to reduce home or workplace exposure to low frequency magnetic fields, Teslatronics has a gauss meter to fit every application, without spending a fortune.*

I've yet to hear of a local supplier of an instrument that measures the strength of an electric field, although as I understand it, an ELF magnetic field is the main concern.

Equation chart

Here's a contribution that I'm sure many readers will welcome...

My father, a long-time subscriber to Electronics Australia, devised this chart (see Fig.3) some years ago to help fellow radio hobbyists and others. I have produced it as a computer graphic, and suggest it might be of interest to your readers. It could make a useful cut-out or backing to a bookmark. (Ian Stein, South Perth, WA.)

Many thanks Ian, for sending us this chart, which is reproduced in Fig.3. A

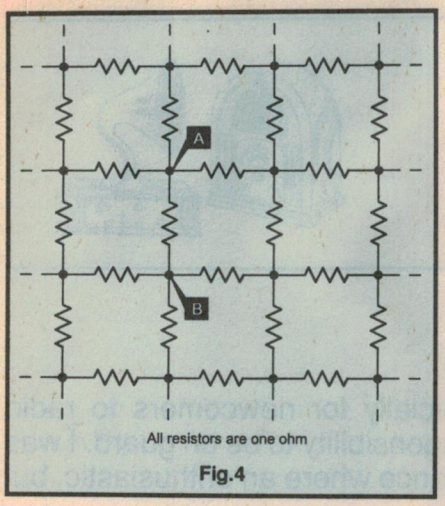


Fig.4

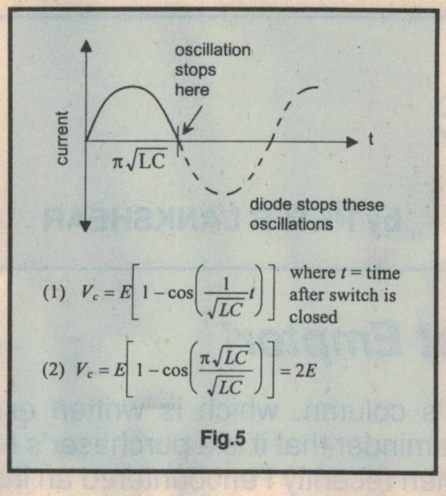


Fig.5

most useful item, as Ohm's law and related power equations are used regularly by most of us at one time or another.

October's What??

Because of the lead time in preparing the magazine, the first reader-supplied solution to the October What?? question didn't appear until December. As a result, I've been overwhelmed with solutions to the question, as many readers thought no one else had responded. Two of these contributions have now been presented, and I promised to include more.

However, on looking through the many letters, I find that most of the solutions are similar, and there seems little point in repeating ourselves. So we'll call it quits on the subject, and many thanks to those who sent me a solution to the problem.

What??

This month's question comes from David Minns (Gracemere, Qld) who was one of the many to send a solution for the October problem. David's question concerns yet another arrangement of resistors and, unlike the October question, includes a solution (thank goodness!). Here's the question:

What is the resistance between any two adjacent nodes in the infinitely large mesh of one ohm resistors shown in Fig.4? For example, between nodes A and B.

Answer to January's What??

The voltage across the capacitor will be exactly 2E volts. That is, twice the source voltage! The diode is initially forward biased and is replaced with a short-circuit. Using Kirchhoff's voltage law, a differential equation that describes the circuit can be written. The solution of this equation is in Fig.5.

The LC resonant circuit thus begins to oscillate, with the current I increasing to the sinewave peak, but then decreasing to reach zero at time (t) = pi times the square root of LC. The current then 'attempts' to become negative to continue oscillation, but at this point the diode becomes reverse biased, and the current stays at zero. That is, the circuit stabilises.

Thus the capacitor remains charged at the voltage across it at time t. Substituting for time t in equation (1) gives equation (2), which solves to 2E. The theoretical current waveform is also shown. ❖

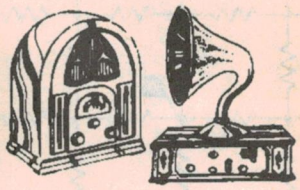
NOTES AND ERRATA

PC Interface for DSE's Teletext Decoder (June 1993): The diagram shown on page 66 (Fig.1) is a little misleading, as it shows the two pullup resistors (R64 and R65) still connected to R66 and R67 after the modification has been completed. Since the new components are connected in series with R66 and R67 (by lifting one end of each resistor), the pullup resistors should be shown at the IC8 end of the communications bus — R64 at pin 13, and R65 at pin 12.

Versatile 40V/3A Lab Power Supply (December 1993 and January 1994): There is an error in the component overlay diagram shown on page 70 of the January issue. The three connections from the power transformer should be reversed in order, so that the 'CT" connection is on the left rather than the right, and therefore connects to the OV line as shown in the schematic. Thanks to Robert Payne of South Australia for bringing this to our attention.

Vintage Radio

by PETER LANKSHEAR



Good advice: 'Caveat Emptor'

The Latin phrase in this month's column, which is written especially for newcomers to radio collecting, is the time-honoured reminder that it is a purchaser's responsibility to be on guard. I was prompted to write on this topic when recently I encountered an instance where an enthusiastic, but inexperienced, collector got a little out of his depth...

An acquaintance of mine, who is a relative novice to the hobby of vintage radio, has been impatient to obtain a 'cathedral' model radio and was delighted recently to have tracked down a classic example — a 1931 Atwater Kent model 80, rare enough in New Zealand and even rarer in Australia. It was not in working condition, but had been kept as an ornament. After much persistence, the reluctant owner, who incidently, is not a collector, was persuaded to part with radio in exchange for a sizeable sum of money.

I was invited by the excited new owner to approve the purchase, but even at first glance, it was apparent that it was far from being in original condition. Immediately obvious was an extra control knob in the centre of the front panel and from even a cursory look at the chassis it was apparent that there were non-standard parts fitted.

Although it is unreasonable to expect absolutely mint condition, to justify being in the upper price bracket a receiver should be in good physical shape, and major components should be authentic. This is especially so in the case of equipment from manufacturers such as Atwater Kent, who used their own unique parts.

At this stage the question had to be asked as to what was expected of the radio. If it was for static display only, then it needed only to have the cabinet refurbished, leaving the chassis 'as is'. This is always an option, especially with very early equipment, but for a classic radio to have any real value, the chassis should still be as original as possible. In this case, as it was hoped that eventually the receiver would be fully restored and operating, it was time for a critical look.

Modern IFT's

Comparison of the photograph of the chassis with that of a model 80 in original condition gives an idea of just how much modification there has been. Where there should be a single large circular IF transformer, there are two much more modern square IF cans, clearly labelled 'Sickles', and the substitute aerial coil has a shortwave winding — implying bandswitching, which is an anachronism in a 1931 A.K. receiver, and of course is the reason for the extra control knob.

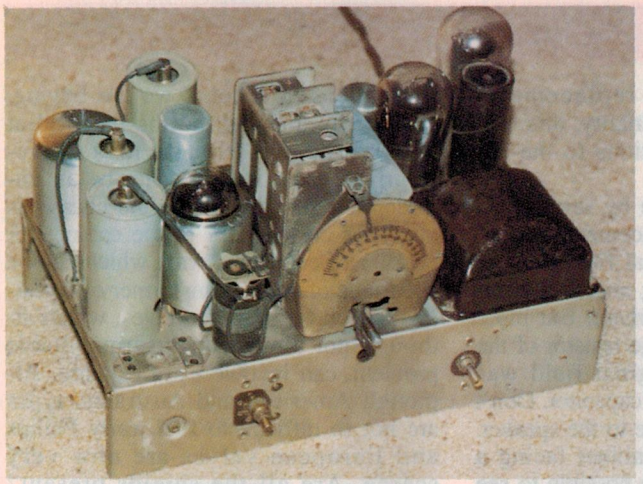
Of the original valve sockets, only those of the rectifier and power output stages remain. Notably absent is an Atwater Kent oddity, a type '27 oscillator valve mounted inside the oscillator coil and its open topped shield. Missing from the rear of the chassis are the name plate and the aerial trimmer capacitor with its knob. In fact, apart from two valve sockets and two remaining shield cans, practically the only original components remaining are the tuning capacitor and the power transformer which, incidently, has tell-tale black deposits around its cover — a sure sign that a rewind will be required. That one item alone, with freight, would not leave much change from $100.

With the chassis upended, there is more evidence of vandalism. Amongst the collection of minor 'foreign' components there is, as anticipated, a relatively modern wavechange switch. At some stage there has been a wholesale gutting and 'modernisation', and to put it bluntly, in its present state, the chassis is of very little worth.

This classic Atwater Kent model 80 in original condition is from the writer's own collection. Its attraction to an enthusiast is understandable but is the expense and effort as featured this month, justified?

Alternatives

The new owner is philosophical and optimistic. A lot of money has already been spent for a receiver that is not playable (or even displayable). The cabinet has been given to a furniture restorer to refurbish and attempt to conceal the extra shaft hole. Restoration of the chassis,



Atwater Kent's nickel plated chassis have a very distinctive appearance and novel features. In several models, including the 80 shown here, to save space, the oscillator valve fits inside the oscillator coil. The valve can be seen here, projecting through the open topped shield to the left of the tuning capacitor.

while not absolutely impossible, would require a considerable degree of luck in finding parts, skill, facilities and time — and there remains the fact that extra holes have been drilled, some in conspicuous places.

Obtaining genuine replacement components of rare receivers can be a problem, because radios of this class are not often written off simply to provide spares. Even if authentic parts can be found, the owner feels that he will need a lot of assistance, as he hasn't sufficient experience to tackle the major restoration work required and even the most skilled restoration will not make it a mint specimen.

Realistically the chassis may be beyond salvaging, and a better approach would be to look for a substitute. Chassis sometimes become available when their cabinets are in such a poor state as to be beyond repair, or become insect-ridden and have to be destroyed.

My recommendation therefore to our enthusiast, is in the first instance to advertise for a chassis in better condition. If this is unsuccessful, as it could well be bearing in mind the rarity of the model, he might be better to cut his losses by selling the restored cabinet, although he would be left with only an expensive experience, rather than the cathedral radio he so much desires.

Important lessons

What lessons are there in this, and what precautions can inexperienced enthusiasts take to avoid similar experiences?

The best policy would be to seek the assistance of a seasoned and knowledgable collector, and I would point out that it is a major function of vintage radio societies to provide this kind of help and advice. However, for inexperienced collectors on their own, here are some hints.

First, is the receiver what it is claimed to be? Confirming the date of manufacture of a receiver requires a lot of experience. Taking the word of the owner can be a very unreliable guide. Time can be well spent in studying old magazines, manuals and circuits, getting an idea of trends and patterns. Grasp all opportunities to look at collections and displays.

There are several reference books that are most helpful, and although they cannot cover every model ever made, they do provide invaluable background information and are of considerable assistance in identification. Some useful titles were listed in this column for July 1993.

Start with a close look at the cabinet. Its condition will not always reflect the state of the chassis, but if the finish is in good condition, and original, the chances are that the mechanical condition of the chassis will be reasonable. First off though, are the tuning knobs all there, do they match and are they original?

Look carefully at the cabinet finish. A popular but misguided trick is to 'freshen it up' by slapping some polyurethane over the original nitrocellulose lacquer. This 'toffee apple' treatment is obvious in a good light, and can only be remedied with a complete refinishing. A few scratches and bruises are inevitable, but look out for missing patches of veneer, structural damage and glue failure. Water damage can cause veneer to disintegrate and bubble. Very early console sets were often on legs, and these may have at some time been shortened.

Insect holes can be an unsightly problem. Borer eggs are usually laid in a hidden area of bare wood, including the entrances to old holes, but the adult beetle can emerge through a visible polished surface. A few holes can be coped with, but look carefully at the edges of plywood for heavy infestation, which could spell real trouble with the cabinet eventually disintegrating.

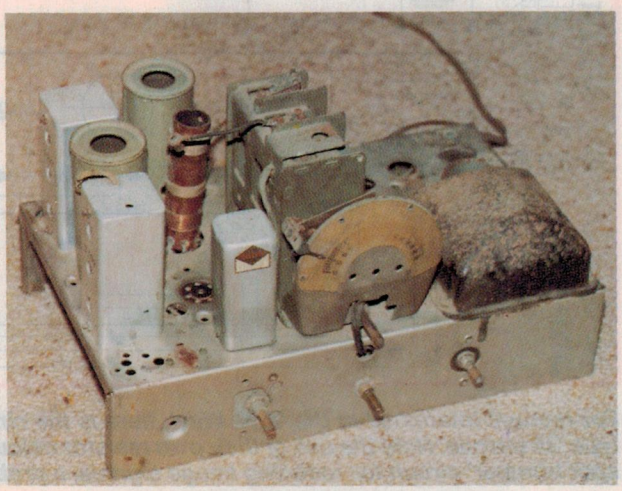
A warning: borer may still be active, and ready to colonise other cabinets. So as a precaution upon acquisition, the interior of a cabinet should always be treated promptly with a methyl chloride solution or similar borer treatment.

Problem holes

Man-made holes added to cabinets are often a greater problem, as they are bigger. Extension speaker and pickup sockets and switches were popular additions to the sides of cabinets, and are difficult to disguise. Worse are holes made for additional control shafts, as in the case of our Atwater Kent. To make matters worse, these are usually in the front of the cabinet, and require very skilled workmanship if they are to be completely disguised.

A very visible modification popular during the late 1930's was the 'updating' of receivers by the fitting of magic eye tuning indicators. This entailed cutting large holes in a most visible part of the cabinet. Sticklers for accuracy will say that such additions should be removed, but often repairs are so difficult that this modification has to be lived with — although it could well have an adverse effect on the value of the receiver.

These comments have applied to



It is obvious that this Model 80 chassis has been considerably modified, with the removal of many of the unique Atwater Kent components. There is also an extra shaft belonging to an added wavechange switch, requiring a fourth hole to be drilled in the front of the cabinet. Note the warning sign of overheating, in a run of burnt wax between the right hand shaft and the transformer cover.

wooden cabinets, but many were made of brittle plastic and should be checked carefully for cracks and missing pieces. Repairs can be very difficult to conceal.

Cabinet condition will be fairly obvious, but evaluating the condition of the contents can be a minefield. Modifications, repairs and alterations vary in the degree to which they can be remedied. Some will be the result of standard servicing and can be readily corrected, but at the other end of the scale is the degree of butchery suffered by the Atwater Kent.

Remember too that sometimes a receiver with a fine cabinet was 'upgraded' by ripping out the original contents and replacing them with a newer chassis.

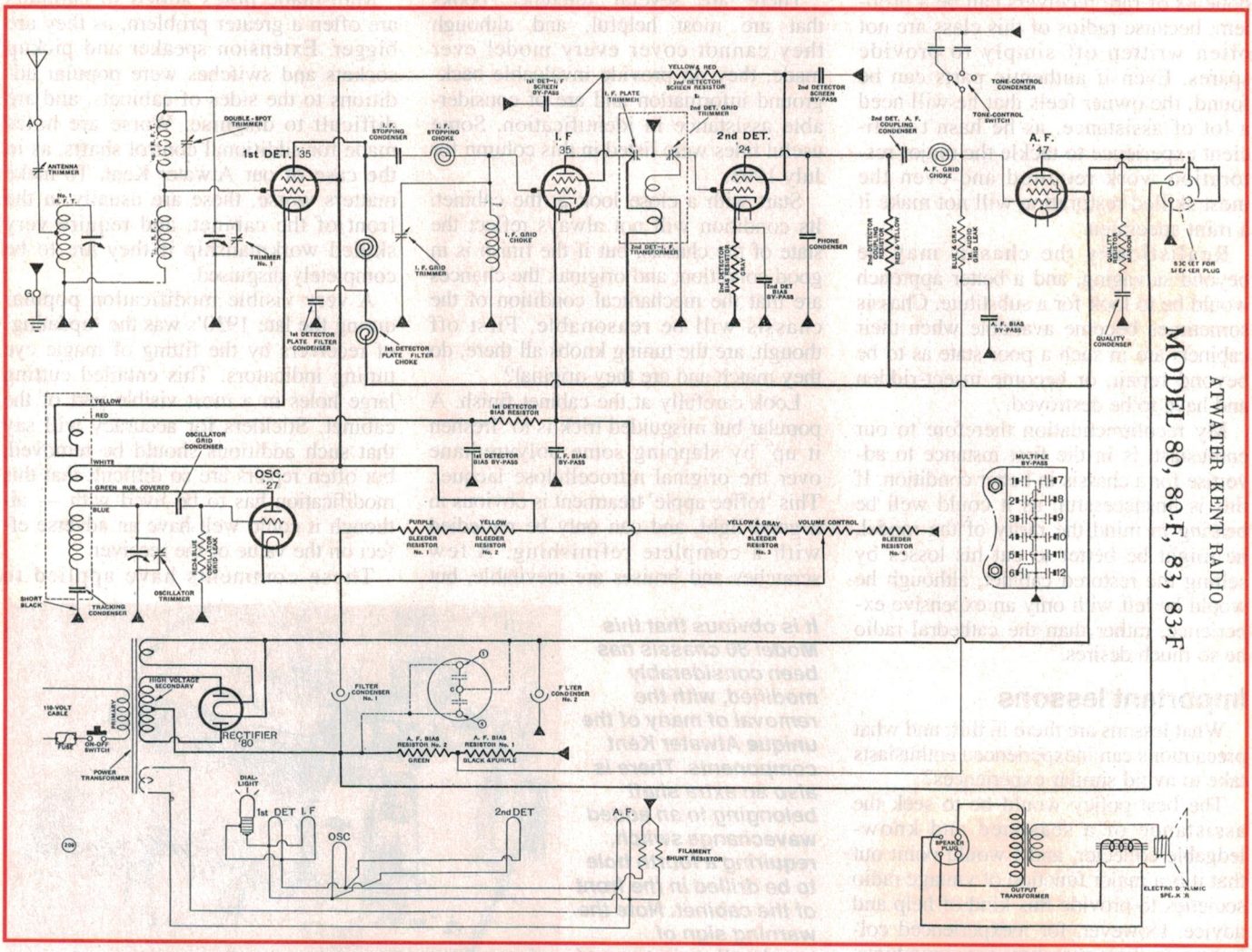
An important component is the loudspeaker. Many prewar sets used speakers with electromagnetic fields, but it is common to find a modern permanent magnet field replacement. Apart from its non originality, this will have entailed modifications to the filtering system.

One popular technique by servicemen when fitting a PM replacement speaker was to retain the original field magnet and winding for filtering and tuck them inside the cabinet somewhere. But more commonly, a high wattage resistor of the same value as the original field was fitted, with an extra filter capacitor. Don't overlook possible damage to the speaker. With the front of the cabinet facing a window, it should not be possible to see daylight through the cone!

Missing valves

If at all possible, and especially if a valuable radio is involved, endeavour to look under the chassis. After all, we look in the motor compartment of a car or the foundations of a house we are buying. Admittedly this may not be practical at auctions and yard sales, but for a leisurely private sale, it should not be an unreasonable request. While the chassis is out, look on the floor of the cabinet for puddles of congealed wax, which can be a warning of power transformer overheating. Check for missing valves, which although not always an insurmountable problem, can involve extra expense. Although American and Australian types are not so difficult to find, early Philips and European valves are now very scarce. Are all the shields present? Authentic replacements are frequently in short supply.

Valves can be a very useful in determining age. Briefly, and as a guide, the 2.5 volt and 4.0 volt heater valves were little used after 1935. In general, 6.3 volt heaters and bases with thick pins were



For readers interested in the 'A.K. Way', here is the circuit of the model 80, using the then newly introduced variable-mu type '35 tetrode. Note the use of their own resistor colour code, which had no logical pattern at all. There is also the 'double spot trimmer' circuit for reducing image signals, a problem with the low IF frequency of 130kHz.

common between the mid 1930's and early 1940's. Octal valves were used increasingly after about 1936, and miniature valves will be found only in post World War II receivers.

The chassis may be authentic, but what about its condition? Apart from its unsightly appearance, extensive rust can be a clue to potential problems. Patches of corrosion can be from rodent deposits, whereas general rust indicates that the radio has been stored in a damp environment and that various components may have suffered. This can vary from soggy speaker cones to corroded coil windings.

Screwheads

Important clues suggesting substitutions or modifications can come from the presence of screws. It was standard practice to rivet valve sockets and small components to the chassis. Be on the lookout therefore for screw heads — especially if unplated, the wrong size, or very shiny. At the same time, empty holes in a chassis may indicate removal of parts.

A very common modification is substitution of the power transformer. Apart from the obvious appearance problem created, unless the voltage rating of the substitute is correct, operating voltages can be very different.

Recently I encountered a set where the power transformer replacement plus the use of silicon diodes meant that the actual high tension was 350 volts instead of the correct 225 volts. This sort of treatment does nothing to enhance the longevity of valves and components. In many respects, it is better to have an original burnt-out transformer than a substitute that is working, for the original can be rewound to provide the correct operating voltages and appearance.

Dials are very visible and there are a number of things to watch for. Older scales were not protected by glass and strangely enough, often were printed with water-soluble ink, making them very difficult to clean. Glass scales may be chipped or broken. The tuning knob should turn freely, without slipping, and the pointer should move correspondingly and smoothly.

Later sets will have cord driven dials, which commonly need restringing. Dials from the 1930's were often driven on the rim of a large diameter disc. Be alert for wear on the edge of disk and pulley, causing the drive to slip.

I hope that these hints will be of help in avoiding some of the problems which may be encountered when buying an old receiver. It takes only a short while to carry out the checks, but they are essential if mistakes are to be avoided.

Finally, don't be put off by the horror stories. Most transactions are much more successful than the one I have described, and end with satisfaction for all concerned. ❖

EXPERIMENTING WITH ELECTRONICS

Continued from page 92

In our electronic version, in Fig.5, IC1 and IC2 both have their own oscillator circuit and pushbutton. The output display is four LEDs per IC, from the first four available outputs of each IC. When PB1 is pressed, counter IC1 cycles, and LEDs 1 to 4 pulse on and off. When the button is released, the display stops at a random value. The same applies to IC2.

We could leave the game there, in which each player presses a button in turn, with both players ready to shout 'snap' when the two displays are the same. But we need a bit more sophistication, which is provided here by the circuit around Q1.

If PB2 is pressed, C2 charges directly from the supply, and transistor Q1 is turned on, held on by the charge in C2 when PB2 is released. This lights LED9, and forward biases isolating diodes D2 and D3.

As a result, the clock terminals of both ICs are pulled low, inhibiting further counting. The displays are therefore frozen, and PB1 and PB3 are effectively locked out of operation.

After about five seconds, C2 discharges, Q1 turns off and LED9 goes out. The clock inputs to the counters are now enabled, so the game can continue. The main purpose of LED9 is to show the players that PB2 has been pressed. The delay stops the other player from robbing you of your win, as the display is frozen for at least five seconds. Also, there's enough time to confirm the button has been pressed when there really was a win.

Have some fun with these simple games circuits! ❖

Hi-tech Cinemas

Continuefrom page 25

This cue brings the house lights up to preset level. Then eight seconds before the end of the credits, another cue initiates the Auto-stop sequence (see above). All that has to be done now is clean the projector and prepare everything for the next show. The computer is left to start the next screening, at the time setting in its program.

It's interesting to show a projectionist of the 'old school' how a modern automated theatre works. They cannot get used to walking away from the equipment and letting it run on its own...

On my holidays last year in Britain, I saw a projection system using an endless loop platter, allowing a show to be repeated all day unattended. The only reason for someone to be attendance is in the case of a breakdown. This system was at the Museum of the Moving Image, on the South Bank in London.

That is another story, but the Museum is well worth visiting by anyone interested in cinema, who is in London on holidays.

That's the end of my story, which I hope has brought you right up to the present in terms of the technology in use at your local cinema.

POST SCRIPT: The Xenon lamp mentioned earlier in this article was finally removed from service at 6046 hours.

The average life of this size Xenon is approximately 1500 hours. Although the lamp was still working, the arc was becoming unstable with the possibility of the lamp exploding and causing damage to the reflecting mirror — and a replacement mirror costs in the order of $1500! ❖

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50 and 25 years ago...

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to 'Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Below we feature some items from past issues.

February 1945

Electronic headquarters: General Electric announced the purchase of a 155 acre plot in Liverpool, five miles from the city of Syracuse, New York, on which they plan to build a new plant and make it the headquarters for the company's electronics department.

Preliminary arrangements call for the erection of several buildings so landscaped that it has been suggested the plant be called 'Electronics Park.'

Luxury airliner: The most modern luxury airliner in England, bearing the arms of the Duke of Gloucester, rests on an airfield near Manchester, says the 'Daily Mail'.

It is a four engined Avro-York, specially built for the use of the Duke and Duchess of Gloucester in Australia. It will leave England for Australia soon to await their arrival.

The airliner contains a stateroom upholstered in red leather, from which the Duke will be able to maintain constant communication with the ground, a rest room and sleeping quarters with thick pile carpets, an ultra-modern tiled bathroom and individual saloons for equerries and ladies-in-waiting.

February 1970

Atomic battery on the moon: The Apollo 12 experiments left on the moon's surface by the lunar mission will be kept functioning for at least a year with electricity developed by a nuclear electric power system.

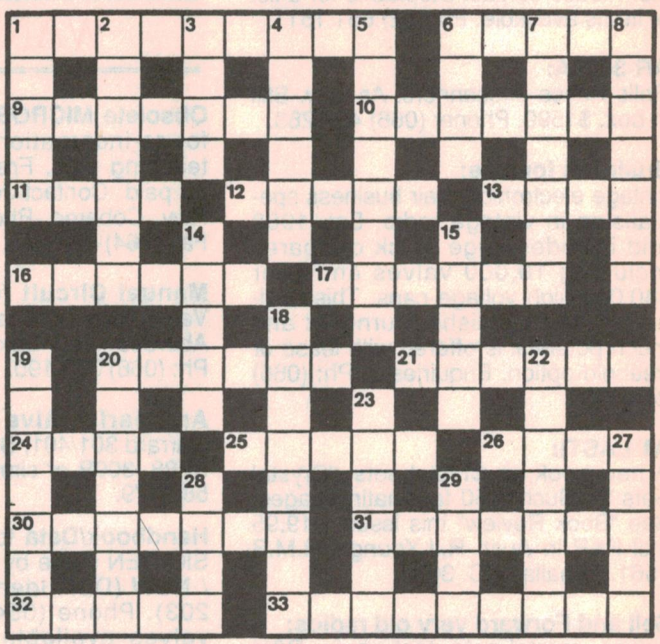
Called SNAP-27, it is one of a series of radioisotope thermoelectric generators (or atomic batteries) developed by the USA's Atomic Energy Commission under its SNAP program. The lunar device was developed as part of a program directed at the development of generators and reactors for use in space, on land, and in the sea. It is designed to provide all the electricity for continuous one year operation of the NASA Apollo Lunar Surface Experiments Package. This is the array of scientific instruments and supporting subsystems deployed by the Apollo 12 astronauts on the lunar surface.

The radioactive isotope chosen for the SNAP-27 fuel was plutonium 238. It is very long lasting, and at the end of 90 years will still be delivering half of its original heat.

Electric powered vehicles: A battery powered electric car, used for mail collection at Mascot Airport, Sydney, is the first of a range of Westinghouse (USA) vehicles to be marketed in Australia.

Initially they will be imported but Australian manufacture is planned. The two passenger vehicle on loan to Ansett Airlines, covers about 15 miles daily in intermittent stop-start service between 1am and 11pm, with overnight battery charging. ❖

EA CROSSWORD



ACROSS

1. Major software brand. (9)
6. Construct. (5)
9. Johnson noise is equivalent to —— noise. (7)
10. Following in phase. (7)
11. Title bestowed on Rutherford. (4)
12. Device invented by De Forest. (5)
13. Aerodynamic force. (4)
16. Said of wave of about 1MHz. (6)
17. Most dense element. (6)
20. Type of antenna. (6)
21. Combined recordings. (6)
24. Composition. (4)
25. Guide object's path. (5)
26. Flashovers. (4)
30. Semiconducting element. (7)
31. Inverting device. (3,4)
32. Reduced in intensity. (5)
33. Telecom communication service. (9)

DOWN

1. Initial part of MOSFET. (5)
2. Removed displayed data. (7)
3. Electrical units. (4)
4. Container for lubricant. (6)
5. Show on TV (8)
6. Faults in equipment. (4)
7. Element discovered by Tennant in 1803. (7)
8. Brand of computer and allied hardware. (8)
14. Transfers data to backing store. (5)
15. Problem in computer program. (5)
18. Metal used in resistance themometry. (8)
19. Floating wreckage. (7)
20. Pair of associated spectral lines. (7)
22. An advantageous purchase. (7)
23. Interface of handheld outdated recorder! (3-3)
27. Perform soldering process. (5)
28. Electrolyte in a simple cell. (4)
29. Acronym for short runway potential. (4)

SOLUTION FOR JANUARY 1995

S	C	R	A	M	B	L	E		F	L	Y	B	Y	S
I			O		A		S		O		A		A	
M	E	T	E	O	R	S		P	R	O	G	R	A	M
U		I		N		E		L		P		D		U
L	I	M	A		O	R	B	I	T		R	E	N	E
A		E		A		S		C		E		E		L
T	O	R	Q	U	E		N	E	W	T	O	N	S	
E			D		R		D		H				R	
	G	A	L	I	L	E	O		D	E	L	E	T	E
F		Z		O		W		W		R		R		P
R	A	I	N		N	O	K	I	A		P	A	G	E
I		M		F	U	L		F		S		A		
N	E	U	T	R	O	N		S	T	U	D	E	N	T
G		T		E		D		O		E				E
E	C	H	O	E	S		A	N	A	L	Y	S	E	R

Electronics Australia's

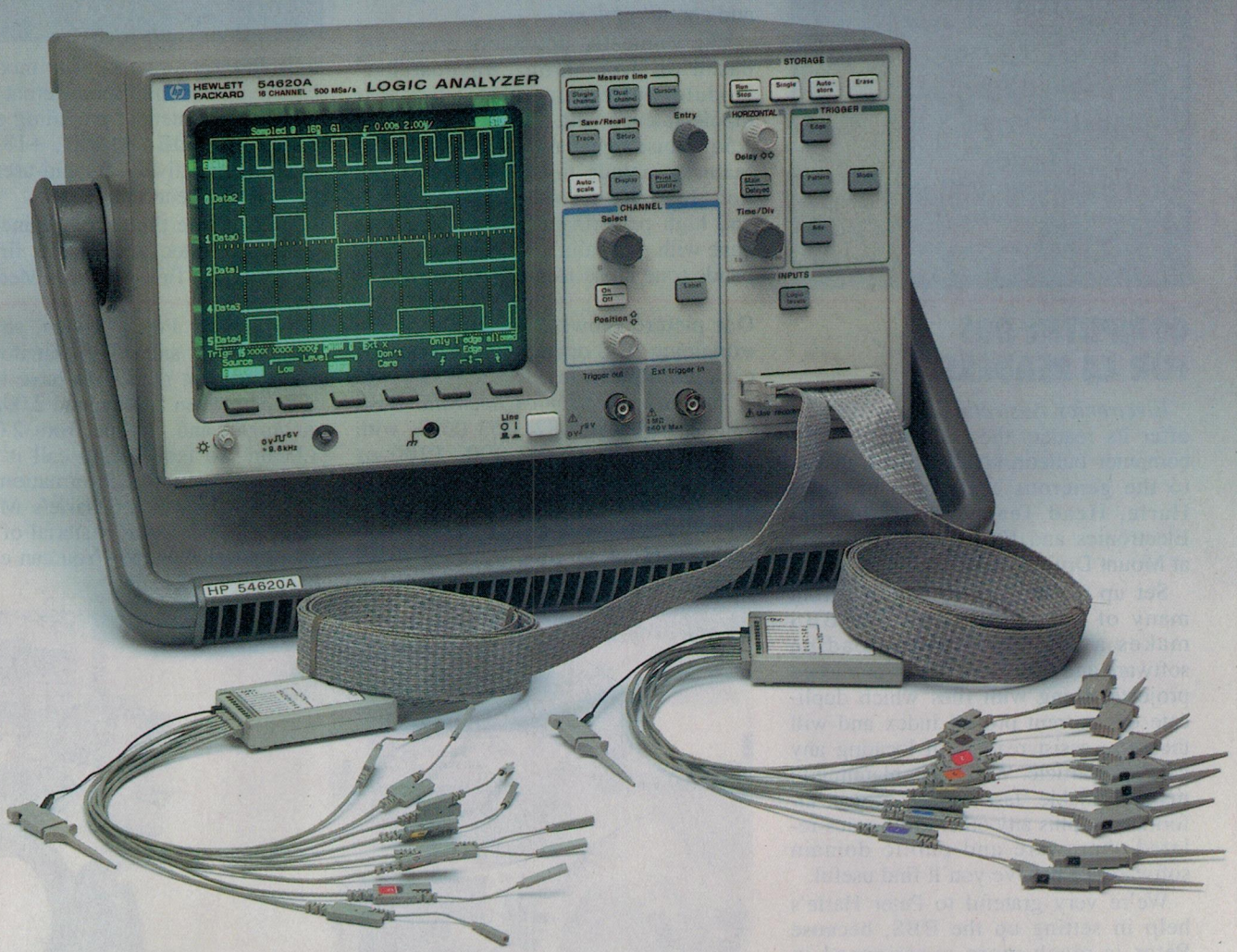
Professional Electronics

S • U • P • P • L • E • M • E • N • T

AUSTRALIAN DESIGNED & MADE MDS TRANSMITTERS, FRONT END FOR PAY TV

LOW COST PC-BASED SERIAL COMMUNICATIONS PROTOCOL ANALYSER

MULTIMEDIA PRODUCTS STAR AT COMDEX '94



NEW HEWLETT-PACKARD HP 54620A 'AFFORDABLE' LOGIC ANALYSER OFFERS 16 INPUT CHANNELS, SAMPLING AT UP TO 500MS/SEC, PLUS THE SAME EASE OF USE AS THE COMPANY'S POPULAR 54600-SERIES DIGITAL SCOPES...

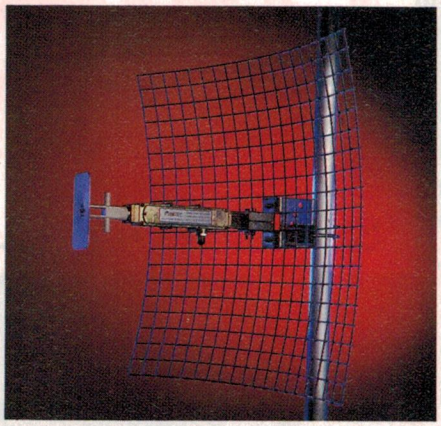
NEWS HIGHLIGHTS

MITEC EQUIPMENT FOR AUST PAY-TV

Brisbane based microwave technology specialist Mitec Limited, recently floated as a public company, has launched a range of MDS (microwave distribution system) products designed specifically for the Australian pay-TV market. The product range includes professional transmitters for use in urban MDS signal distribution, high performance downconverters for use as part of consumer receiving systems, and a variety of associated equipment.

The MDS transmitters include both fixed frequency and 'agile' models, with power output capabilities of 10W, 50W and 100W. Fully designed and manufactured in Australia using the latest GaAsFET devices, the transmitters incorporate digital AGC loops to maintain output power level, are 100% protected against excessive output VSWR and feature microprocessor-based diagnostic and control systems.

The domestic downconverters are based on a common 'Wavecatcher' module which integrates a low-loss dipole antenna with a front end offering 1.5dB noise figure and 30dB gain. Other features include low power consumption, low phase noise ('digital ready') and high performance filter circuits to cope with Australia's two separate MDS bands (one close to the frequency used by microwave ovens). The module can be integrated with four different types of microwave antenna, providing effective gains of +6dB, +12dB, +18dB and +24dB respectively. Its end-user cost is expected to be around $250.



Even before the formal launch of the products, Mitec received its first order from pay-TV firm Australis Media.

COMPUTER BBS FOR *EA* READERS

Electronics Australia is now able to offer its readers the convenience of a computer bulletin board system, thanks to the generous assistance of Peter Harle, Head Teacher of Industrial Electronics and Electrical Engineering at Mount Druitt College of TAFE.

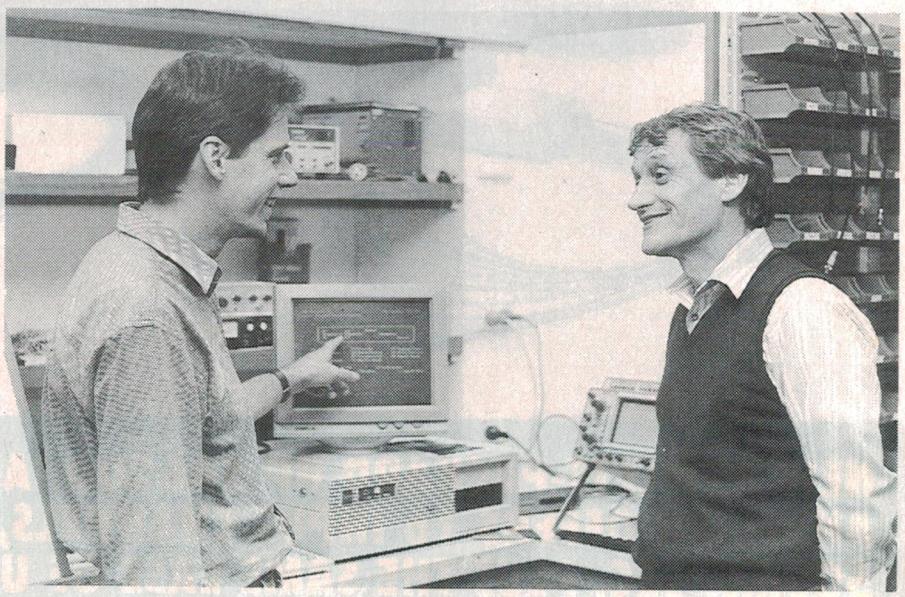
Set up in response to requests from many of our readers, the new BBS makes available for downloading software and firmware for our published projects, along with files which duplicate our current project index and will therefore assist readers in locating any particular article. We're also planning to make available 'last minute' project information, plus any other electronics-related shareware and public domain software we believe you'll find useful.

We're very grateful to Peter Harle's help in setting up the BBS, because Peter is much more experienced in doing this than we are. He's the 'sysop' (system operator) of the very successful Mt Druitt TAFE Information Service BBS, which in fact he set up some time ago, and for the time being he's also acting as our own BBS sysop until we gain enough experience to 'go it alone'. Our picture shows Peter Harle (right) explaining BBS operation to *EA* technical editor Rob Evans.

The new *Electronics Australia* BBS can be called on (02) 353 0627, with your modem set for 300, 1200 or 2400bps full duplex operation and a data format of '8-N-1' (eight data bits, no parity and one stop bit). We're trialling a version of the 'Ezycom' BBS management program written in Australia by Peter Davies, so it's all quite friendly and self explanatory.

Our current plan is to have the BBS active between 7.00am and 2.00am each day/night, and off-line from 2.00am to 7.00am. So feel free to call it up, and avail yourself of the information.

By the way Peter Harle's Mt Druitt TAFE BBS also has material of interest to electronics people. You can call it on (02) 839 1310.



CENTRAL COAST AMATEUR FIELD DAY

The Central Coast Amateur Radio Club's Annual Field Day, regarded by many as the premier event for amateur radio in Australia, will be held on Sunday February 26 at Wyong Racecourse, Howarth Street Wyong (a five-minute walk from Wyong station). The Field Day has become justly famous, and in previous years many amateurs and electronics/computer hobbyists have travelled interstate in order to attend.

Traditional events include stands and displays by all major amateur radio equipment suppliers, and many suppliers of general electronic equipment and components; lectures on topical technical subjects; amateur TV, satellite TV and packet radio demonstrations; a 'flea market' and car boot sale of unwanted equipment; a radio 'fox hunt'; and stands providing information on the activities of the WIA, WICEN, ALARA etc.

Admission to the event is $8 for adults, seniors and pensioners $5 and children under 12 free. The gates open at 8.30am. Further information is available from the CCARC, PO Box 252, Gosford 2250 or phone (043) 40 2500.

INNOVATIVE 'SHOWER TIMER'

Australian engineer David Whitby, well known for his inventions such as an energy-saving compact fluorescent lamp ballast and a telephone protection device, has developed a new product known as the Gum Leaf Shower Timer ST4.

Designed to help consumers conserve water and also save on their water and energy bills, the ST4 is a compact waterproof timer which mounts inside a shower recess and times shower use. At the end of four minutes, it emits a series of loud 'beeps', to remind the shower user that their water consumption time has expired. The beeps only stop when the water is turned off and left off for one minute.

No user controls are provided, and operation is fully automatic — the ST4 senses water use by detecting the accompanying high frequency sound emissions.

The ST4 attaches to a tiled wall using two high quality suction cups. It is powered by a low cost 9V battery, which lasts for approximately one year with average use. RRP of the ST4 is $34.50 plus $3.90 postage and packing, and it's available from GumLeaf Energy Saving Systems, PO 12717 A'Beckett Street Post Office, Melbourne 3000; phone (03) 663 7227 or 1 800 628 645, or fax (03) 663 7202.

Yamaha Music Australia has delivered two all-digital audio post production Systems to AAV Australia in Melbourne. The systems comprise hard disk based audio DSP workstations, integrated with Yamaha DMC1000 automated digital mixing consoles.

NEW HONOUR FOR PROF. MARTIN GREEN

The contribution to solar energy commercialisation by Professor Martin Green, Director of UNSW's Centre for Photovoltaic Devices and Systems, has again been recognised, this time with a Clunies Ross National Science and Technology Award.

The awards are made each year by the Board of Governors of the Ian Clunies Ross Memorial Foundation and are for 'excellence in the application of science and technology.'

The citation for Professor Green read: 'For exceptional research, personal vision and drive over more than 20 years, including the development of 'Buried Contact Solar Cell Technology', which is the most successfully commercialised new solar cell technology developed in the past 15 years.'

Commercial production of the centre's buried contact solar cells achieves efficiences of 16 to 18%. This is appreciably higher than the 11 to 12% achieved by competing commercial cells, and is attained at marginal extra cost per cell, yet results in substantial savings in costs per unit energy produced and in 'balance of system' costs.

The buried contact technology, which has been patented by Professor Green through Unisearch (UNSW's R&D and technology transfer company), carries several other advantages which combine to give the cells a decisive commercial advantage.

In addition, the technology is a major component in the latest thin film cell technology design that has been announced by the centre. When it reaches full scale production, the thin film technology is expected to make solar electricity cheaper than any present source of electrical power.

NEW MAGAZINE

A new publication has joined *EA* and its fellow titles at Federal Publishing Company: *Good Planet*, directed at young people with an interest in ecology, energy conservation and reduction in pollution.

NEWS HIGHLIGHTS

The new publication takes a deliberately offbeat and 'informal' approach, with liberal use of cartoons, humour and a bright, colourful layout. At the same time the articles are informative, and designed to raise reader awareness of the factors which determine global 'health', and how problems can be addressed.

Good Planet is available at newsagents now, priced at $4.95.

NEWS BRIEFS

- The 13th ***Microelectronics Conference*** will be held in the Adelaide Hilton, Adelaide SA, July 16-19 1995. For more information contact the IREE Society, PO Box 79, Edgecliff 2027; phone (02) 327 4822.
- ***St Lucia Electronics*** has been appointed Australian Distributors for Chemtronics of Georgia, USA. Included in the product range are Chem-wik and Chem-wik Lite desoldering braids.
- ***Independent Information Technology Training*** is running a LAN Design and Implementation course in Sydney from 29- 31 May; Melbourne from 5-7 June, and Brisbane 1-3 March 1995. For more information phone (02) 252 2844.
- Dr Rowan Gilmore has been appointed by ***SITA*** as the Sydney-based Regional Technical and Operations Director for Australasia and the South Pacific.
- Switch mode power supply manufacturer ***Amtex Electronics*** has been formed into two separate divisions: Power Supplies and Displays & Systems.
- Geoffrey Smith, formerly Manager Strategic Technology at Optus Communications has joined ***Scientific-Atlanta Australia***.

THAI PARTNER FOR PRECISION POWER

Australian power line filter specialist Precision Power, based in Brisbane, has signed an agreement with Thailand firm Encorp, whereby the latter will manufacture and market in Thailand the new range of power line filters which Precision Power recently launched in Australia. Encorp has been an agent for Precision Power for some five years, and already manufactures weighing machines and other electronic equipment.

The agreement is expected to strengthen considerably Precision Power's presence in Asia, where demand for power filtering and conditioning equipment is growing rapidly. John Wedgewood, the firm's national sales manager, says the potential is enormous:

"We have to export to developing

25TH ANNIVERSARY OF TAIT ELECTRONICS

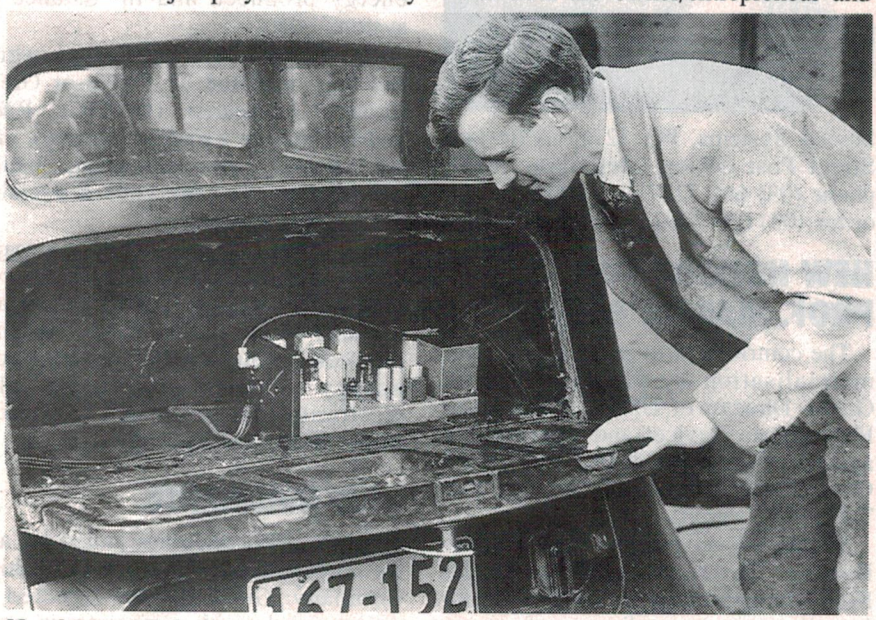
Tait Electronics, which is now celebrating its 25th anniversary, has grown from a small organisation with a core staff of 12 to a major international company with 700 employees in 22 offices around the world.

The New Zealand headquartered company has become one of the world's three largest manufacturers of two way mobile radio systems, with an annual turnover of more than $100 million.

Tait is a major player in two way radio in Australia, as a supplier of equipment and a partner in trunking network joint ventures. Its dynamic growth is the result of specific development policies of its owner and founder, 76 year old Angus Tait.

Angus Tait's involvement in the mobile radio business has been mainly motivated by his passion for the technologies and products. In his view, entrepreneurs whose main objective is to make money cannot engender a high level of staff loyalty. Angus considers the primary aim of business must be some visible, higher objective that both the owner/entrepreneur and employees see as mutually beneficial to their futures.

Mr Angus Tait who owns and guides the fortunes of Tait Electronics, one of the world's largest manufacturers of two way nobile radio systems.



Mr Angus Tait with one of the first two way mobile radios that he installed in a car.

The successful pursuit of these objectives will in time create financial rewards for both owners and employees. Tait Electronics' unique ethos of reinvesting 100% of its profits back into the business reflects his business philosophy.

It is appropriate that in the year Tait Electronics celebrates its 25th Anniversary, Angus also celebrates his 76th birthday, still very actively involved as Chairman and Managing Director in Tait's day to day operations.

countries which are just starting to develop a power infrastructure. The grottier the electricity, the better the type of power filter they need."

Precision Power has manufactured the US-designed Islatrol power filters for some years, and has been exporting to New Zealand, Papua New Guinea, Malaysia, Singapore, Thailand and Hong Kong since the 1980's. According to John Wedgewood the company has more than 10% of Australia's estimated $20M power filter market.

AT&T SELECTS MICROCELL FOR WIRELESS NETWORKS

A novel approach to building intelligent wireless networks for shopping centres, hospitals, airports and commercial or residential sites has been developed by Australian company MicroCell Systems, under a contract awarded by AT&T.

The 'Mobility Manager' product will initially support the CT-2 frequency, which uses small, relatively inexpensive mobile telephone handsets. However, the design is frequency independent, so AT&T and MicroCell are evaluating the feasibility of supporting multiple frequencies for Australia and other countries.

The Project Director of MicroCell Systems, Aldo Kiamtia, said his company viewed the Mobility Manager developed contract as a gateway to AT&T's global market place.

"It's put MicroCell Systems on the map with the leading world wide communications organisation," Mr Kiamtia said. "AT&T has given us a great opportunity to let the rest of the world know what we can do."

MicroCell Systems integrated UK and US technologies with their application to meet the needs of customers. Mr Kiamtia said the system incorporated an 'underlying intelligence' that made it faster and easier to use than similar products.

EUROPE RECOGNISES NATA TEST DATA

A recognition agreement signed between Australia's national laboratory accreditation body, NATA, and a major European laboratory accreditation cooperation, EAL, will greatly enhance the acceptability of test data and trade between Australia and Europe.

The agreement facilitates the recognition of Australia's NATA accredited testing laboratories and reduces the need for the retesting of many Australian products in Europe. In turn, the agreement allows Australian importers of European goods to accept product test data from those laboratories in Europe accredited under EAL (European Cooperation for Accreditation of Laboratories).

Yokogawa Australia has gained quality assurance approval to ISO9001/ AS3901, extending to all Yokogawa offices throughout Australia and covering its range of instruments, applications engineering and services. Pictured are Yokogawa's MD Peter Smith and Marketing Director Barry Mitchell, with the plaque.

NO-REPEATER CABLE FOR BASS STRAIT

A new world record will shortly be set in a crossing of Bass Strait, according to Siemens. The record means that all telecommunications transmissions will travel under the strait without any amplification on the way — a whopping 240 kilometres.

"It's a new world record for long distance transmission," says Dr Ockert van Zyl, General Manager, Telecommunications and Manufacturing for Siemens Ltd, in Melbourne. "We believe we have bettered the previous world record — set in Denmark — by nearly 40 kilometres."

Under Siemens' contract with Telstra, new, high powered optical amplifiers will be located on land at Waratah Bay, on Victoria's south west coast, and at Jacob's Boat Harbour, on Tasmania's north western coast. These will give a mighty boost to all Telstra transmissions between Tasmania and the mainland via the new cable.

Eventually all transmissions between Tasmania and the mainland will be carried by this new link, which will have 18 optical fibre lines. Each line will be capable of carrying the equivalent of 30,000 voice calls simultaneously.

The new cable connection is due for completion at the end of May.

The first systems using the new cable will operate at 622 megabits per second, managed by Siemens' latest synchronous digital hierarchy equipment, with the option to upgrade to a 2.5 gigabits per second system later on.

ALCATEL'S BILL PAGE-HANIFY RETIRES

On December 31st last, Bill Page-Hanify, AM retired from his position as Managing Director of Alcatel Australia, the country's largest designer, manufacturer and exporter of telecommunications technology.

He has become non-executive-Chairman of Alcatel Australia, and continues as Chairman of submarine systems company, Alcatel TCC. He is also on the board of the parent company's Alcatel Submarine Systems group headquartered in Paris.

Mr Page-Hanify began his career with Alcatel (or STC as it was known then) as a senior engineer in 1960. Throughout that time, and especially over the last 10 years while he has been Managing Director, he has participated at senior levels in the remarkable and rapid transformation of the telecommunications industry, both at home and overseas, as it has become one of the world's most advanced and truly global enterprises. ❖

Construction Project:

PC-BASED SERIAL PROTOCOL ANALYSER

You can do a certain amount of serial data link troubleshooting with a break-out box, but for the really tricky problems you need a protocol analyser. Commercial analysers are *very* expensive, but the author has developed a simple, low cost way to do the job with almost any IBM-compatible PC. All you need is an adaptor cable, and special software he has written...

by RICK MATTHEWS

There are two tools that any serious data communications developer or troubleshooter either has, or wishes they had: a break-out box and a protocol analyser. You can use these tools to monitor Lap Link, XModem, INTERLNK in DOS 6, serial printer communications such as Postscript, data transfers to and from bulletin boards and E-Mail, serial mice, fax transmissions, amateur packet radio, plotters, or anything else that transfers data through a serial port using the V24 or RS232 standards.

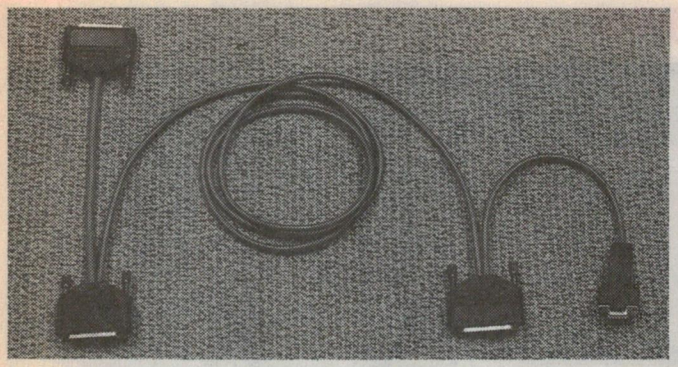
Generally speaking, break-out boxes are for observing the electrical signals on the various handshaking leads on data links — and, if necessary, rearranging them. Whereas protocol analysers are used to observe the *actual data* that is passing up and down the link.

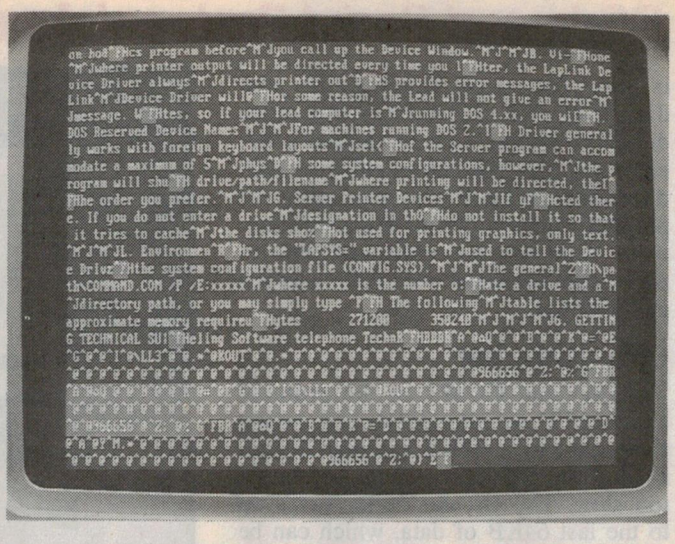
These two tools complement one another; but because the break-out box is simple and cheap (typically $20 to $1000) and the protocol analyser is complex and expensive (typically more than $20,000), most people have confined themselves to solving those problems that can be solved with a break-out box and have abandoned problems that could have been solved with a protocol analyser.

The cheap protocol analyser presented here, while not the full-blown device you would expect to pay $30,000 for, nevertheless goes a fair way to help solve those difficult problems which normally require a very expensive protocol analyser.

One special benefit of this simple protocol analyser is that it is much

The author viewing his protocol analyser software on the right hand PC, monitoring a link running on the left hand PC.





Above: The kind of adaptor cable needed for the protocol analyser. At left are the connectors for the actual data link.

Right: A close up of the PC screen when the protocol analyser software was monitoring a Lap Link data transfer.

easier to set up. At least you do not have to go through a galaxy of complex, time consuming and error-prone set up procedures every time you use it. Because this protocol analyser works with asynchronous serial data circuits using the RS-232 and V24 hardware and signalling standards, it covers most serial data communications situations these days anyway.

What you need

All you need is a PC, the adaptor cables as shown, and the software. The PC can be anything from a Pentium to, in some cases, even an XT. Both COM1 *and* COM2 must be present and working.

You only need about an hour in most cases to collect the data you want, so a borrowed PC will do. If you make on-site visits for maintenance purposes you probably carry a portable PC for maintenance anyway, so you may only need to carry the extra cables — which is a lot better than carrying a protocol analyser everywhere 'just in case'!

The analyser uses standard data rates, with the upper limit being determined by the speed of the PC and the SIO chips used for its COM1 and COM2 ports. A Pentium or 486DX with NS16550 SIO chips (or their equivalent) should work up to 115.2K bits/second, whereas an XT with 8250 SIO chips will probably be limited to 9600b/s.

There are some jumpers that must be properly installed on the PC's I/O card, to allow the use of interrupts on COM1 and COM2. In most portables and a few PC's, these jumpers are on the mother board. The jumpers connect IRQ4 to COM1, IRQ3 to COM2, and often connect OUT1 and/or OUT2 from each of the SIO chips to a tri-state gate to complete the interrupt paths to the adaptor bus.

These jumpers are usually intact when the PC is sold new, but could have been removed to allow IRQ3 and IRQ4 to be used for other cards such as tape backup or sound cards. Jumper errors are more likely than anything else to prevent the protocol analyser from working.

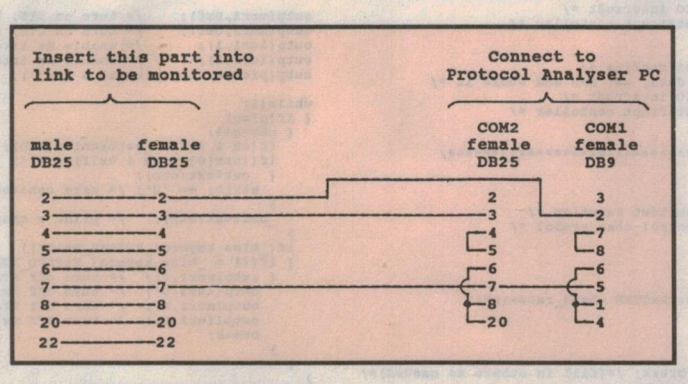
The cables

The cabling provides a straight through connection for the serial link being monitored, and a connection to the receive data inputs on COM1 and COM2 of the protocol analyser PC as shown in the diagram. Interference to the link being monitored will be minimal.

There is just a bit of extra loading on the receive and transmit data leads. All other handshaking leads are unaffected.

The only other problem you will have with the cables is whether to choose DB25 (25 pin) or DB9 (9 pin) plugs and sockets, for the connections to the data link under test. Since both standards are used without any real rules, you may need a lot of 25 to 9 pin converters — or a lot of alternative cables.

I have used 25-pin connectors throughout except the female socket that plugs into COM1 on the protocol analyser PC. This suits most desktop PCs. Portables tend to use DB9 connectors for both COM1 and COM2 while XTs often use only DB25 connectors.



The connections required for the protocol analyser's adaptor cable. Either DB25 or DB9 connectors can be used as desired, to suit your computers...

The display

The screen display shows data flowing in real time, with a blue background for one direction and a red background for the other. All ASCII printed characters are shown normally, while all control characters are shown prefixed with a circumflex (^) followed by the ASCII character formed by adding 40 hex to it (i.e., a carriage return is shown as ^M, and a line feed is shown as ^J, etc.).

The display is 80 characters across the screen by 25 lines down, without any formatting. The carriage returns, linefeeds, backspaces, tabs, etc., are prevented by the software from operating normally. Those control characters just appear in sequence in the current line as ^M, ^J, etc. Other protocol analysers use this or a similar method of display as a standard option.

The data is saved in the analyser's buffer using one byte per character, with each character stored as 7-bit ASCII with the most significant bit used to indicate data direction. The upper bit

PC-based Serial Protocol Analyser

is set for data flowing in one direction and cleared for the other direction. If you want to capture a full eight bits per character in either or both directions, you will have to modify the program to store the direction information — in, say, an additional byte to make two bytes per received character in the buffer.

Circular buffer

COM1 and COM2 on the protocol analyser PC are interrupt driven, saving their data in a 64KB circular buffer. Polling the SIO ports would be simply too slow. The circular buffer saves up to the last 64KB of data, which can be written to a file for later analysis (not shown in the listing). 64KB is chosen as a reasonably large but realistic value for analysis, yet allows the analyser to run indefinitely without the risk of overflow. This is handy for catching those infrequent intermittents, that need long monitoring periods.

The software

The software has all been written in Microsoft's Quick C, version 2.5. There are a few non-ANSI functions used, so the code may not be completely portable to other compilers; but most of it should be. The key to success is the proper use of interrupts. SIO interrupts

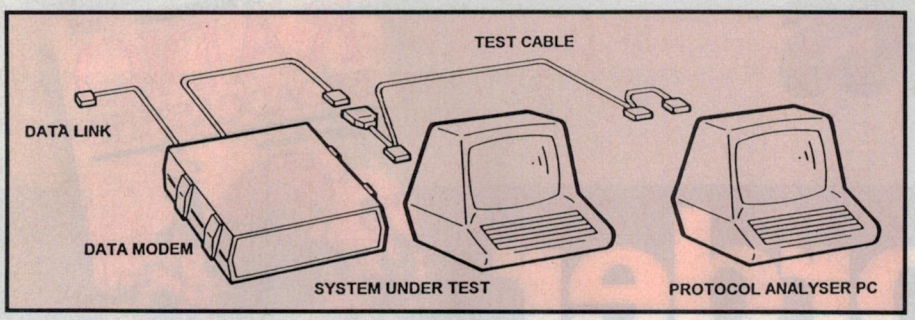
Another view of the protocol analyser running on the right hand PC, monitoring a data transfer using Lap Link to the left hand PC.

are not well described in most references. The sequence I use for setting up these interrupts is:

1. disable the SIO chips' interrupts
2. write the interrupt routine addresses into the correct low memory locations
3. set the SIO chips' data rates, bits per character, parity, and stop bits
4. set the circular buffer pointers
5. turn the SIO chips' OUT1, OUT2, and handshaking on
6. enable the SIO chips' receive interrupts
7. unmask the programmable interrupt controller's SIO interrupts

When an interrupt occurs from either COM1 or COM2, the programmable interrupt controller handles it virtually immediately except if some higher

```
/*********************************************************
          PROTAN - Protocol Analyser using a PC.
  AUTHOR: Rick Matthews, Adelaide, South Australia.
*********************************************************/
#include <stdio.h>
#include <bios.h>
#include <graph.h>
#pragma check_pointer(off)
#define COM1 0
#define COM2 1
#define BLUE 1
#define RED 4
unsigned char far *p;
unsigned char far *q;
unsigned dat1=0x3f8, ier1=0x3f9, mcr1=0x3fc, lsr1=0x3fd; /* COM1 */
unsigned dat2=0x2f8, ier2=0x2f9, mcr2=0x2fc, lsr2=0x2fd; /* COM2 */
unsigned picmsk=0x21, pictrl=0x20, eoi=0x20;
FILE *fo;

/*********************** INTERRUPT HANDLERS ***********************/
void interrupt siointl()    /* interrupt routine */
{ *p++ = inp(dat1) & 0x7f; /* get the data, clear MSB and store it */
  outp(ier1,1);            /* reset SIO interrupt */
  outp(pictrl,eoi);        /* reset interrupt contoller */
}

void interrupt siointz()    /* interrupt routine */
{ *p++ = inp(dat2) | 0x80; /* get the data, set MSB and store it */
  outp(ier2,1);            /* reset SIO interrupt */
  outp(pictrl,eoi);        /* reset interrupt contoller */
}

/****************************** MAIN ******************************/
main(int argc, char **argv)
{ unsigned char data;
  unsigned char ch;
  char str[2]={" "};  /* string for _outtext function */
  char con[2]={"^"};  /* string for control-char symbol */
  int rate, baud_rate;
  int i;

  if(argc < 2)
  { printf("Protocol Analyser usage is: PROTAN <baud_rate>\n");
    exit(1);
  }
  sscanf(argv[1],"%d",&rate);
  switch(rate)
  { case 1200: baud_rate = _COM_1200; break; /*(fill in others as needed)*/
    case 9600: baud_rate = _COM_9600; break;
    default:   printf("Not a valid Baud rate!\n");
               exit(3);

  printf("\nPROTOCOL ANALYSER using COM1 and COM2:\n\n"
         "%s Baud, 8 bits no-parity, or 7 bits odd or even parity,"
         "and 1 stop bit.\n"
         "          (Use function key 'F10' to exit)\n\n"
         "Hit any key to proceed . . . ",argv[1]);
  getch(ch);

  _setvideomode(_TEXTC80);
  _wrapon(_GWRAPON); /* end-of-line wrap & end-of-screen scroll ON */

  outp(ier1,0);                /* disable SIO interrupts */
  _dos_setvect(12, siointl);  /* set int vector 12 (IRQ4 used by COM1) */
  outp(ier2,0);
  _dos_setvect(11, siointz);  /* set int vector 11 (IRQ3 used by COM2) */
  data = (_COM_CHR8 | _COM_STOP1 | _COM_NOPARITY | baud_rate);
  _bios_serialcom(_COM_INIT, COM1, data);
  _bios_serialcom(_COM_INIT, COM2, data);

  /* use the 0x8000 segment as a circular buffer */
  p=q=(char far *)0x80000000;

  outp(mcr1,0xf);     /* turn on RTS, DTR, /OUT1, /OUT2 */
  outp(mcr2,0xf);     /* turn on RTS, DTR, /OUT1, /OUT2 */
  outp(ier1,1);       /* enable Rx interrupt */
  outp(ier2,1);       /* enable Rx interrupt */
  outp(picmsk,(inp(picmsk) & 0xe7));  /* unmask SIO interrupts */

  while(1)
  { if(p!=q)
    { ch=*q++;
      if(ch & 0x80) _setbkcolor(RED);  else _setbkcolor(BLUE);
      if((str[0] = ch & 0x7f) < ' ')
      { _outtext(con);
        str[0] += '@'; /* make control char into alphabet char */
      }
      _outtext(str);   /* print a char with background colour */
    }
    if(_bios_keybrd(_KEYBRD_READY))
    { if((i = _bios_keybrd(_KEYBRD_READ)) == 0x4400) /* f10 key? */
      { outp(mcr1,0);  /* turn off RTS, /OUT1, /OUT2 */
        outp(ier1,0);  /* turn off Rx interrupts */
        outp(mcr2,0);  /* turn off RTS, /OUT1, /OUT2 */
        outp(ier2,0);  /* turn off Rx interrupts */
        break;
      }
    }
  }
  _setvideomode(_DEFAULTMODE);
}
/****************************** END ******************************/
```



Monitoring a typical data link using the protocol analyser. The PC on the right is running the analyser software, with the adaptor cable patched into the link between the centre computer and the modem on the left.

priority interrupt has occurred to delay it briefly. The interrupt handling sequence for both SIO ports is:

A. read the data from the interrupting SIO port
B. clear the upper bit for COM1 or set the upper bit for COM2
C. save it in the buffer
D. increment the buffer pointer
E. reset the SIO interrupts
F. reset the interrupt controller
G. return to the point of interrupt in the foreground program.

The main loop, or foreground program, displays the data from the buffer. If the two buffer pointers are equal, then there is no new data so no action is taken by the foreground program. If they are not equal, there must be some data to display and the main loop gets it, checks the upper bit to determine direction and therefore background colour, checks it to see if it is a control character and displays it with a preceding '^' if it is; otherwise it just displays it. The main loop also checks the keyboard for function key [F10] keystrikes. If an [F10] keystrike is detected, the program restores the SIO chips to the inert state, saves the circular buffer to a file (not shown in the listing), and exits.

The use of colour backgrounds for indicating direction makes it necessary to use graphics mode and consequently the Quick C **outtext()** function instead of the usual **printf()** function.

The circular buffer may not look like one at first sight, because there is no check to see when the top is reached. In this case no top of buffer check is necessary because the CPU is operating in real mode and the segment register setting of 8000 hex remains unchanged while the offset increments from 0000 to FFFF hex and back to zero again automatically. The effect of this is that the buffer is circular, with an absolute RAM address range from 80000 to 8FFFF hex, with an automatic end-to-end wrap around.

The way the circular buffer pointers have been used will cause run-time errors unless you turn the check pointer function off, using the pragma shown near the top of the listing.

Using this kind of buffer is not a good programming practice, but it is fast. A limitation of Quick C is that only data rates up to 9600 bits per second are provided. This is not a hardware limitation, so that if you want higher speeds you have to avoid using the **_bios_serialcom()** function in Quick C and resort to directly programming the SIO chips, in accordance with the chip's data sheets.

Using the analyser

When the hardware is installed as shown in the diagram the protocol analyser can be run from the command line: **PROTAN <baud_rate>**
where **baud_rate** is any data rate supported by the hardware and software. The minimised listing shows just two of these as examples (i.e., 1200 and 9600), but you can add others to the source code as required.

I have chosen arbitrarily to use the function key [F10] to exit the program. Any other key or keys can be used provided the software is altered to support it.

The listing shown omits the file handling needed to save and examine the data later. This has been done to reduce the printing space and to concentrate on the real task. ❖

EDITOR'S NOTE

Mr Matthews has very kindly provided us with copies of both the source and executable files for both the protocol analyser (PROTAN) program and a matching program to review saved files (PROTDISP), for distribution to anyone wishing to build his analyser. Interested readers can obtain copies of these files by sending us a formatted **high density** floppy disk (5.25"/1.2MB or 3.5"/1.4MB), plus a cheque for $5.00 to cover copying and return postage within Australia.

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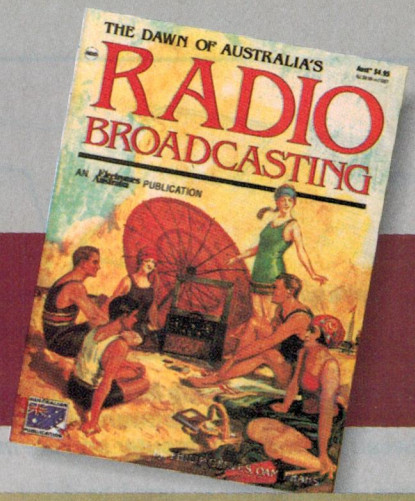
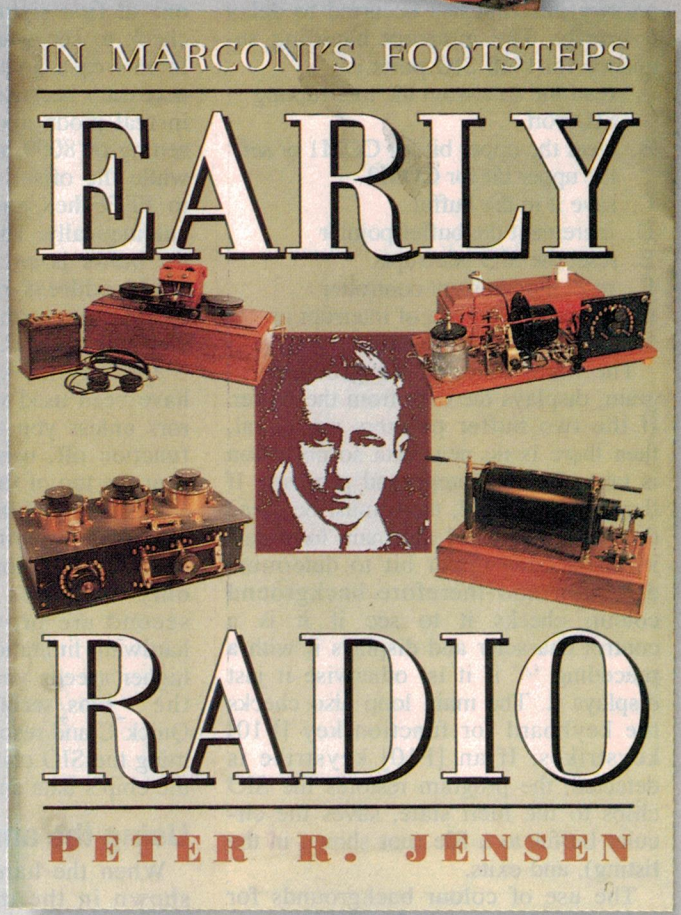


Listen up!!!

Marconi played a key role in developing radio as a practical medium of communications, and although there have been a number of books written about him, in this new one Peter Jensen has taken a rather different approach. The basic chronological account of Marconi's life and achievements is intertwined with a separate but linked narrative of Peter's own recent visits to key sites, such as the Villa Grifone near Bologna, Salisbury Downs, Dover, Poldhu and Clifden.

For the more technical reader, there's also a 'second half' of the book giving an expanded description of many items of Marconi's equipment and construction details for making replicas.

It all makes much more interesting reading than most other books dealing with this kind of subject.



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NEW PRODUCTS

Fibre optic modem

Optical Systems Design has released its OSD157 fibre optic modem. The unit was originally designed for tactical deployment military applications, where the emphasis is on extreme ruggedness and extremely low electromagnetic emissions, necessary for a high degree of security. As a result it is built into a machined enclosure and incorporates extensively filtered power and data lines.

The modem is a small self contained unit which can provide full duplex synchronous or asynchronous communications over a two-fibre optical cable. It can be supplied either as an eight line RS232/MIL-STD-188 modem or as a six line RS422 modem. The eight line unit is internally selectable for either RS232 or MIL-STD188.

The modem operates with all commonly available multimode fibres over at least 3km and can be optioned to operate over at least 10km of single-mode fibre. While normally used as a modem, the OSD157 can also be used as a six or eight channel multiplexer. The unit can be supplied either as a stand-alone or for mounting in the OSD380 2RU (88mm) high 19" rack mounting chassis which supports up to 14 such modems.

For further information circle 242 on the reader service coupon or contact Optical Systems Design, 2/5 Vuko Place, Warriewood 2102; phone (02) 913 8540.

Handheld scope/multimeter

The TekMeter 565 combines a true RMS multimeter and an auto ranging digital storage scope (DSO) in the one compact handheld package. It has been expressly designed for use by field technicians in the areas of installation, repair and maintenance.

The instrument features a large easy to read LCD display, which provides in addition to the normal analog and digital measurements, simultaneous readout of max, min, max minus min, hold and delta hold. In the scope mode the meter is an autoranging two channel DSO with a bandwidth of 5MHz and a sampling rate of 25MS/s. On-board cursors allow the measurement of delta volts, delta time and inverse delta time.

The multimeter section of the instrument has a 3-3/4 display (4000 counts) and measures DC voltage in the range 400mV to 850V with a best resolution of 1mV and a stated accuracy of 0.5% + 5 counts. In the AC voltage range the unit can measure the true RMS values of voltages between 400mV and 650V in the frequency range 1Hz to 5kHz. Resistance can be measured up to 40M ohms with a resolution of 0.1 ohms. The meter also features an audible continuity test facility.

RF signal generator

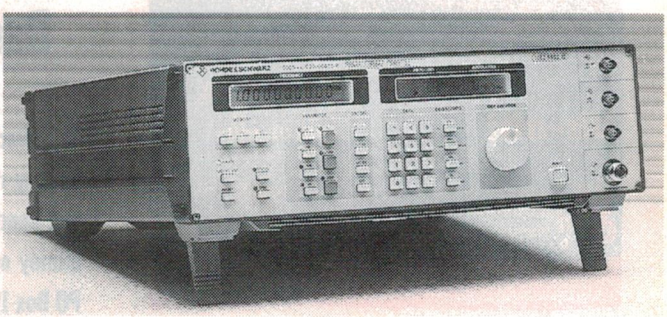
The new SMY RF signal generators from Rohde & Schwarz are designed for testing AM, FM and QM receivers. They can also be used for component measurements. The generators come in two models covering the frequency range from 9kHz to 1040MHz, or from 9kHz to 2080MHz. The generators are claimed to be versatile yet cost effective, making them suited for universal use in a laboratory, or in production and servicing environments.

The level range of the generators is from -140dBm to 13dBm, which is sufficient even for high-sensitivity receivers. High level accuracy and low RF leakage allow accurate and undegraded sensitivity measurements. The high accuracy of the carrier frequency allows reliable testing of pagers and receivers with digital squelch.

Because the instruments have a 1Hz frequency resolution, they are also suitable for measurements on extremely narrowband devices. The integrated AF synthesiser output is from 1Hz to 500kHz which can also be used as an AF signal source for external applications.

The generators can be integrated via an IEC 625/IEEE 488 interface into an automatic test system.

For further information circle 241 on the reader service coupon or contact Rohde & Schwarz, PO Box 6105, Silverwater 2128; phone (02) 748 0155.



The Tekmeter is available for hire from Tech-Rentals. For further information circle 243 on the reader service coupon or contact Tech-Rentals, PO Box 621, Ringwood 3134; phone (03) 879 2266.

Battery monitor is PC based

Anton Piller (Australia) has released a new product to make battery monitoring simpler and less expensive. The system, designed and manufactured in Australia, continually and accurately monitors battery voltages, temperatures, charge and discharge currents of complete battery strings and/or individual cells.

The Battman battery management system incorporates software which allows the operator to quickly identify defective battery cells with a glance at the computer monitor.

Graphical displays and coloured bar charts highlight the condition and performance of the batteries and this information is continually recorded so that the history can be retrieved, printed and assessed at any later time. The most significant benefit of the system is the ease of identifying when a fault occurs, or more importantly before a fault develops.

For further information circle 244 on the reader service coupon or contact Anton Piller (Australia), 4 Expo Court, Mt Waverley 3149; phone (03) 562 8466.

Parallel interface tester

The new PIT system is a professional handheld Centronics parallel interface tester, designed to help solve problems between a computer and its printer. Powered either from a DC plug pack or run on internal batteries, the PIT system is available in two models, the PIT 100 and the PIT 200.

Both models feature ASCII 'fax' testing and can measure and

READER INFO NO. 22

READER INFO NO. 23

display data rates along the interface. Both units also feature display LEDs to show input and output status signals, and have built in test functions accessible with a push of a button. The PIT 200 has a step function to monitor the transmission of individual characters. The PIT 200 can completely test parallel port operation as well, and there's a facility to store user test files for graphics printers and plotters. The PIT 100 is priced at $150 and the PIT 200 costs $200.

For further information circle 246 on the reader service coupon or contact TCG Manufacturing, 53 Balfour Street, Chippendale 2008; phone (02) 698 5000.

Compact phone plug

The Neutrik NP2RCS is claimed to be the world's smallest right angle mono phone plug. Measuring 65mm in length with a 16mm body diameter, the plug uses Neutrik's chuck-type cable strain relief and features a robust metal connector body and nickel plated connector surfaces. The connector can be assembled quickly and easily and provides ground termination without soldering.

For further information circle 248 on the reader service coupon or contact Amber Technology, 5 Skyline Place, Frenchs Forest 2086; phone (02) 975 1211.

Side actuated SMT switch

Alcatel Components has released a new surface mount switch that features actuation in a plane parallel to the PC board surface. Designated the KSM, the new switch is a low profile tact switch that is single pole with normally closed contacts.

The switch contacts are designed for momentary actuation and can handle 0.2W at 24V DC. Switching current is a maximum of 50mA DC and operating life at maximum switching power is greater than 500,000 cycles. Contact bounce time is less than 3ms. Operating force required to actuate the switch is between 0.48 and 0.72 newtons with a travel of 0.35mm. The switch can be safely reflow soldered via its gullwing style contacts. Physical size is approximately 6mm square with a height of 1.5mm. Packaging is 16mm wide continuous tape

Conductive silver and carbon greases

Planned Products has introduced two new greases developed for applications requiring electrical conductivity, lubrication and protection. Available in silver and carbon formulations, the new Circuit Works conductive greases protect assemblies from wear and environmental hazards, while providing excellent electrical and thermal conductivity.

When used at low to medium loads and speeds, the greases lubricate and protect assemblies, while forming conductive pathways, contacts, connections, static drains and grounding. Based on advanced silicone lubricants, the new greases are chemically inert, thermally stable and nonflammable. Assemblies are protected from moisture, oxidation, radiation, corrosion, and corrosive atmospheres with a single grease application.

The 7100 Circuit Works Silver Conductive Grease is formulated for maximum electrical and thermal conductivity with typical resistivity of <0.01 ohm/cm. The silver grease is thermally stable from -57° to 252°C and features a dropping point of 255°C. The 7100 Silver Grease exhibits excellent thermal conductivity of 50 (BTU/Hr/Sq.Ft/in/F°) while maintaining a flash point of <520°C. Unworked and worked penetration are 210 and 250 respectively, with steel on steel wear measured at 1.5mm.

The 7200 Carbon Conductive Grease has typical resisitivity of <30.0 ohm/cm. The carbon grease provides effective lubrication from -57 to 252°C. No dropping point was observed at the 520°C test limit. The 7200 Grease maintains a flash point of <520°C. Unworked and worked penetration are 335 and 338 respectively, with steel on steel wear measured at 2.0mm. New Circuit Works Conductive Greases are available in a variety of packaging options including plastic syringes and bulk jars.

For further information contact Planned Products, 303 Potrero Street, Suite 53, Santa Cruz, CA 95060-2760, USA; phone (408) 459 8088, or fax (408) 459 0426.

READER INFO NO. 24

reels with 2000 switches per reel and the product can be picked and placed by all standard production equipment.

The KSM is ideal for applications such as 'push to talk' switches, position sensing switch, card edge reset switches and other soft tactile card edge applications.

For further information circle 247 on the reader service coupon or contact Alcatel Components, 248 Wickham Road, Moorabbin 3189; phone (03) 444 1566.

Logic analyser is 'like a scope'

Hewlett-Packard's new HP 54620A Logic Analyser is the latest addition to the firm's range of 'affordable' test and measuring instruments, and unlike many logic analysers is desgined to ffer the same ease of setup and use embodied in the popular HP 54600 series of digital scopes.

The HP 54620A provides 16 logic analysis channels, with the ability to trigger on edges, patterns, duration times and sequences. It samples at 500MS/s, to ensure the capture of narrow glitches, and provides a bright, crisp screen display updated 15 times per second regardless of the number of active channels. As with the 54600 DSO's the analyser also provides automatic measurement of frequency, period, duty cycle, width, delay and hold time.

A handy feature of the HP 54620A is the same kind of 'Autoscale' button provided on the 54600 scopes, allowing very rapid and convenient setup. The analyser provides a trigger output which can be used to trigger a scope, and is also compatible with the HP 54650A and HP54651A interface modules — and the HP34810A BenchLink/Scope software — used by the 54600 series scopes.

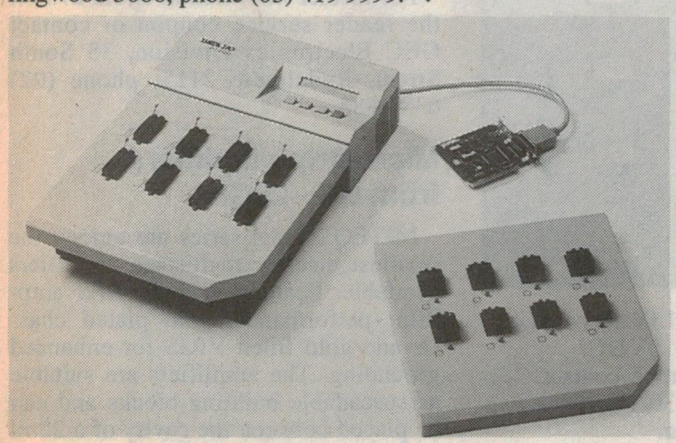
The Australian price of the HP 54620A Logic Analyser is $4498 plus tax. Further information is available by calling HP's Customer Service Centre on 13 1347.

Midrange gang programmer

Data I/O has introduced the PSX400, a new multiple purpose gang or set programmer for low to medium volume prototyping and manufacturing applications.

Memory and microcontrollers can both be programmed on the PSX400. Four and eight socket modules are available for 32-pin and 48-pin DIP, and other packages such as PLLC, SOIC, and TSOP are supported. TaskLink allows users to set up standard 'programming' tasks that include all the steps required to process a certain set of devices or functions. The PSX400 is designed to download serially at up to 38.4kbs, but can be enhanced with an optional IEEE-488 port to achieve transfer speeds of up to 170kB per second.

For further information circle 245 on the reader service coupon or contact Nilsen Technologies, PO Box 930, Collingwood 3066; phone (03) 419 9999. ❖



Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

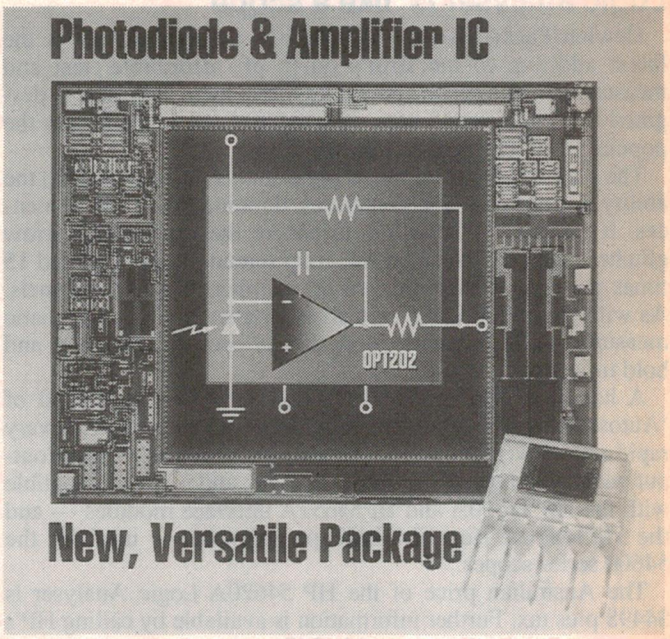
Transparent SIP photodiode/amplifier

Burr-Brown's new OPT202 is packaged in a new 5-pin SIP that allows light to originate from the 'side' of system boards rather than from perpendicular sources. The device combines a large 2.3 x 2.3mm photodiode, precision FET input trans-impedance amplifier and 1M feedback resistor on a single chip to provide high performance at a low cost.

The IC is suitable for many industrial applications including medical and laboratory instrumentation, position and proximity sensors, photographic analysers, machine tool controllers, and smoke detectors. Its innovative combination of photodiode and amplifier eliminate many problems associated with discrete design, such as leakage current errors, noise pick up, and gain peaking due to stray capacitance. Photodiode responsivity is 0.45A/W at 650nm.

Key specifications include: 1M feedback resistor, 2mV dark errors, 0.45A/W 650nm) responsivity, 400uA quiescent current, 0.05% nonlinearity, and +/-2.25 to +/-18V supply range.

For further information circle 280 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone (03) 878 0824.



Surface mount voltage regulators

Featuring full thermal shutdown and current overload protection, the new ZMR250 and ZMR500 fixed voltage regulators from Zetex deliver 2.5V and 5V respectively. Both devices are available in 2.8 by 1.3mm SOT23 surface mount packaging.

In standby mode, the new regulators take only 25uA and 50uA respectively, which is a reduction in power consumption of up to 100 times relative to the standard 78L series. As well, the devices are unconditionally stable and don't need external capacitors.

Output current capability of both versions is 50mA, and power dissipation is 500mW for the SOT23 package or 600mW for the TO92. Line regulation for the ZMR250 is 10mV (worst case) for all input voltages from 4.5V to the maximum input rating of 20V. Regulation of the ZMR500 is also 10mV maximum for inputs down to 7V.

Applications include mobile telephones, cameras, laptop PCs, camcorders and pagers. Over their operating temperature range of -55° to 125°C, the regulators have an average temperature coefficient of typically 0.1mV/°C, when delivering an output current of 5mA. Output tolerances are 2.438 to 2.563V for the ZMR250 and 4.875 to 5.125V for the ZMR500.

For further information circle 273 on the reader service coupon or contact GEC Electronics Division, 38 South Street, Rydalmere 2115; phone (02) 638 1888.

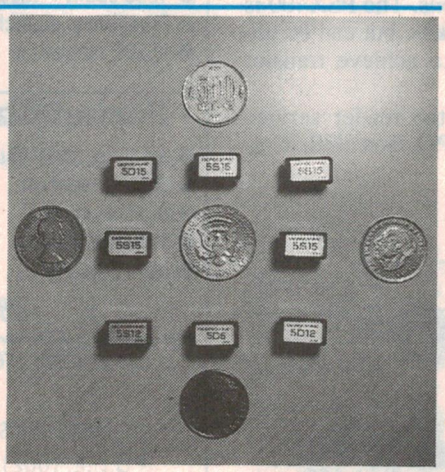
DC to DC converters

A new series of ultra miniature 0.9W, single and dual output DC to DC converters have been announced by Cygnus Technology from Japan. The devices are available in 21 different configurations.

The inputs and outputs are isolated, they feature excellent regulation, thermal load protection circuitry and on-board short-circuit protection.

Their metal case reduces noise radiation and guarantees high reliability against vibration, moisture and heat.

Other features include: 16 pin DIL compatible package, 12 x 20 x 10mm size, high efficiency, low noise and burn-in and testing during manufacture. The input voltage range is 5, 12 and 24V DC, giving single outputs ranging from +5 to +15V and dual outputs from +/-5V to +/-15V DC.



For further information contact Cygnus Technology, 4-30-15, Okusawa, Setagaya, Tokyo, Japan.

Microstrip amplifiers from 0.1 - 20GHz

MITEQ's NSH series are among the smallest discrete multistage amplifiers available. Features include AFS amplifier performance, gold plated chassis and gold filled VIGS for enhanced grounding. The amplifiers are suitable as cascadable building blocks and can be placed between the cavity of a 25ml

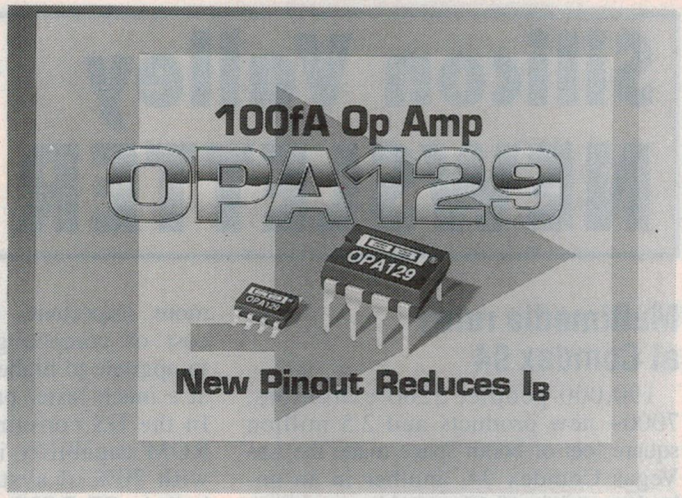
Electrometer-grade op-amp

Burr-Brown's new OPA129 is an electrometer-grade operational amplifier in 8-pin DIP and SO-8 surface mount packages. Its 100fA (max) input bias current makes it ideal for use with high impedance sensors, low drift integrators, pH probe amplifiers, and ion gauge measurement.

The device features dielectrically-isolated FET fabrication, which reduces input bias current by a factor of 10 to 100 and eliminates isolation-junction leakage current without the need for small geometry FETs. The pinout allows rooms for circuit board guard traces — even with the tiny SO-8 package.

Key specifications include an ultra low bias current of 100fA, an offset voltage of 2mV, drift of 10uV/°C, and a noise figure of 15mV/√Hz at 10kHz.

For further information circle 275 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone (03) 878 0824.



substrate. They are supplied for easy soldering or with a screw mounted chassis. Custom frequency, gain and noise figure options are also available, and a three year warranty is also offered.

For further information circle 272 on the reader service coupon or contact Electronic Development Sales, PO Box 822, Lane Cove 2066; phone (02) 418 6999.

Ultra-low dropout regulator transistor

Zetex has launched a PNP power regulator resistor claimed to feature an unrivalled saturation-versus-gain performance in its class. This is important for manufacturers of portable equipment as it can extend battery life.

In high current equipment the need for power regulation with low dropout, high efficiency and low EMI, tends to prohibit the use of many monolithic devices. This has resulted in the development of monolithic controllers that use an efficient PNP series pass transistor. Developed for this purpose, the ZBD949 features a high gain across a wide operating current range and a very low collector to emitter saturation voltage.

The TO126 packaged power regulator transistor has a typical collector-emitter saturation figure of 80mV at 1A, rising to 360mA to 5A. Gain of the transistor is typically 200 at 1A and 140 at 5A. At the device's peak current handling capability of 20A, DC gain is still 35. Maximum collector-emitter voltage of the ZBD949 is 30V, and its collector-base rating is 50V. Properly heatsinked, the device can dissipate 25W. It can dissipate 2W without any heatsinking. Capable of operating over a temperature range of -55 to 200°C, the ZBD949 is suitable for a wide range of applications, including automotive under-bonnet circuitry.

For further information circle 278 on the reader service coupon or contact GEC Electronics Division, 38 South Street, Rydalmere 2116; phone (02) 638 1888.

Trident licenses C-Cube's MPEG-1

Trident Microsystems, a supplier of graphics and multimedia ICs for the PC market, has licensed C-Cube's CL450 MPEG-1 video decoder technology.

The integration of video and graphics technologies will reduce system costs while increasing functionality and performance as multimedia systems move into the mainstream PC market. This integration will bring the cost of building MPEG-1 playback boards below the $80 mark, and make the addition of multimedia video capabilities to graphics boards or mother boards very inexpensive.

Under the terms of the agreement, Trident has the right to use C-Cube's CL450 circuitry for integration into its video and graphics controllers and also establishes a relationship between the two companies for further cooperation on future products. C-Cube, in turn, will have the opportunity to sell some of these integrated products.

For further information circle 271 on the reader service coupon, or contact Veltek, 18 Harker Street, Burwood 3125; phone (03) 808 7511.

Semi-custom linear ICs

The ZLA700 from Zetex is a semicustom linear IC that features a flexible linear array process. Involving a series of eight standard bipolar arrays with between 33 and 630 transistors, the process cuts both end product and design costs. End product costs are reduced since the arrays allow high component use. Design costs are reduced as the user carries out the chip design on a PC, via low cost, easy to use software.

Besides providing accurate emulation and modelling routes, Zetex advocates the building of a prototype. To this end, discrete components accurately matching their array based counterparts are available, providing a high degree of confidence in the success of the design. Since only one level of the IC manufacture is customised, development and production time scales are substantially reduced. Additional benefits are reliable end products with no restriction on minimum order quantity, and extremely low NRE charges, bringing semicustom linear ICs within the reach of many small to medium sized companies.

For further information circle 276 on the reader service coupon or contac GEC Electronics Division, 38 South Street, Rydalmere 2116; phone (02) 638 1888. ❖

Silicon Valley NEWSLETTER

Multimedia rules at Comdex 94

190,000 people, 2200 exhibitors, 7000+ new products and 2.5 million square feet of booth space made the Las Vegas Comdex 94, another in an unbroken string of 16 ever-bigger shows. And there appears no end in sight, as close to half a million people are expected to visit the annual event by the end of the decade.

One of the reasons for the continued explosive growth of the PC market is the strong emergence of the home computing market. Already accounting for 40% of the PC market in the United States, the consumer PC segment will increase to 50% this year. And between 25 and 40% of customers in the retail area are first time PC buyers, according to reports out of the retail industry.

More so, of all the PCs now in use in business and the home, more than half are out dated in terms of enabling their owners to enjoy the benefits of the multimedia revolution. And what's more important, the rapidly falling cost of computing is allowing users to upgrade to higher levels of machines at a much faster pace than in the past. In the US consumer PC market CD-ROM capability is virtually a must, with 70% of systems sold featuring built-in CD-ROM.

Unlike the previous Comdex, which was dominated by the first PDAs, Pentium and PowerPC machines, and wireless computing products, Comdex 94 had few if any breakthrough, show stopping products that have the potential of moving the industry in new directions — with the exception of Windows 95 and Microsoft's Marvel on-line network. Ironically, neither of the two products officially exist, and probably won't be available for another six months. But you would never have guessed that, as it was hard to find any booth that wasn't touting some support for Windows 95. Many firms demonstrated prototypes of Windows 95 versions of their software.

IBM made a big splash with its recently released WARP version of OS/2, encouraging visitors to 'GET WARPED'. But the mood at Comdex was clearly tilted towards Windows 95, on which most software companies are betting their resources. Most analysts and industry executives at the show predicted the program will take the industry by storm, easily exceeding the phenomenal sales of Windows 3.1 just three years ago.

In contrast to the general excitement over Windows 95, there was virtually no attention paid at the show to the announcement made just days before the show by Apple, IBM, and Motorola that they had agreed on a new PC hardware platform. Few seemed to care.

At his news conference, Microsoft's Bill Gates reserved his harshest words not for federal investigators examining Microsoft's competitive practices but for the IBM/Apple/Motorola alliance to produce a new personal computer clone. Gates insisted he couldn't understand why anyone would consider the alliance a big deal. "They basically announced they finally figured out how to have a common BIOS," Gates said, referring to the software on a chip that serves as a sort of glue between microprocessor and operating system. "I'm still wondering what took so long."

PCs with built in telephone communications and video teleconferencing capabilities look like becoming common in the next two years. Integrated technology displayed its CompuPhone 2000, which features a modified 101 key PC keyboard and built-in headset.

Multimedia big time

Among industry trends it was impossible to ignore the explosive proliferation of multimedia, which has been building up for the last three years — culminating in a near take over of the show.

Whereas in 1993 the multimedia exhibit was contained in the smallest of Comdex's seven exhibit halls, this time the entire massive Sands Convention Center had been taken over by the multimedia industry — accounting for more than 1300 booths at the Sands alone, with hundreds more companies exhibiting some form of multimedia products in other areas of the show.

Long lines formed at booths featuring glitzy state of the art multimedia productions. At least two companies, Virtual I/O and VictorMaxx, introduced consumer level 'virtual reality' headsets.

Virtual I/O of Seattle and VictorMaxx Technologies of Deerfield, Illinois said

they are ready today to satisfy consumer demand for consumer virtual reality head gear, a market that is expected to quickly become a billion dollar industry over the next couple of years.

VictorMaxx showed its new CyberMaxx visor (US$700), which provides a completely emersive stereographic environment in which to play computer and video games. The headset, which weighs just over 13 ounces provides a 63 degree viewing angle. By turning your head, players can get a 360 degree view of their surroundings. And they will see a virtual sky or ceiling when looking up and the appropriate floor type (street pavement, carpet, etc.,) when looking down.

The CyberMaxx is aimed specifically at PCs and video games. VictorMaxx said the company is currently working with independent game developers to produce virtual reality games that take advantage of its headset.

Meanwhile, Virtual I/O had long lines waiting at the theatre in its booth, where the company was using action filled video to demonstrate its versatile virtual reality visor which can be used to display images from a range of input sources, including PCs, television, VCR or laserdisk.

The basic unit costs just US$399. A $700 version adds a 'headtracker' which, just like the CyberMaxx, allows for true virtual reality games by using head movement to control what is seen on the screen in front of the player.

Unlike the CyberMaxx, the 'Personal Display System' from Virtual I/O allows users to retain peripheral vision of their surroundings, making the device useful in industrial and medical applications. The maximum viewing angle is limited to 180 degrees.

Finally, while the Virtual I/O devices use two small projection TVs, the CyberMaxx uses two colour active matrix LCDs which provide a sharper image. Both systems feature high powered stereo headsets.

PowerPC puts on big effort

The IBM/Apple/Motorola alliance again put together a big effort in support for the PowerPC. In a large tent outside the main convention hall, some five dozen companies were showing applications written for the PowerPC. Even Microsoft was represented, showing for the first time, Excel and Work, SQL Server, and SNA Server applications running native on the Windows NT operating system for the PowerPC.

Ann-Marie Larkin, who is vice-president at Motorola's RISC Microprocessor Division, said that already more than 300 PowerPC applications are out on the market with dozens being added each month. Larkin said the alliance has recently introduced development tools that simplify the process of porting applications to the PowerPC platform.

Still, beyond the Apple Macintosh, there is no computer maker that yet sells a significant number of PowerPC based machines. Many had hoped IBM would have been able to get its PowerPC based desktop system on the market by Comdex, but IBM has postponed the launch until after development of the OS/2 based operating system is completed.

As far as Apple is concerned, the company launched two new PowerMacs. The PowerMac 6100 is a machine that sports both a PowerPC 601 and Intel 486-DX/2-66 processor, allowing the computer to run Macintosh, Windows, DOS and native PowerPC applications all at the same time. In fact, users can transfer data between applications from the different operating systems with simple point-and-click 'cut and paste' moves. The system also supports two monitors, without the need to add an additional video card.

Meanwhile, the PowerMac 8100/11 features the 110MHz version of the 601 PowerPC chip. This machine is aimed at multimedia users; it has 16MB of RAM and a 2-gigabyte hard disk and can run Windows and DOS applications.

IBM Workgroup

In an effort to show its determination to leave its proprietary past behind and become a company committed to open, flexible, and accommodating architectures, IBM used Comdex to launch 'IBM WorkGroup', a broad range of Desktop functions to automate much of the information flow that is critical to the success of a group of people working together in an organisation.

IBM WorkGroup is based on a number of 'components' the company has released separately during the past 18 months, while still more elements of the WorkGroup are in development and will be added later.

Some of the basic functions available today include fax, directories, scheduling, calendars, chalkboards, work management, messaging, multimedia libraries, search technology, personal video-conferencing, and decision support. Speech recognition is high on IBM's list of priorities to add to the environment.

In a key feature, IBM has built in intelligent data 'agents' which automatically perform tasks for their user.

"This is a new concept", explained Ralph Pollock, program manager of WorkGroup. "You have a research agent working for you in the network that will feed you data based on a set of rules, and which can learn based on what you select. Another agent, much like a secretary, lets things happen on your behalf. A message from your boss marked 'Urgent' will automatically have you paged or generate a fax to your hotel. The action is taken on a pre-determined combination of events and rules."

Pollack said WorkGroup can be scaled for organisations as small as 10 people to international conglomerates with 100,000 workers.

The Virtual I/O stand featured a theatre, where the company was demonstrating its 'Virtual Reality' visor/headset, using action filled video material.

Gates and Grove unveil their visions

Andy Grove and Bill Gates, whose microprocessors and operating software represent the heart and soul respectively, of the massive personal computer industry, used their key note addresses at Comdex to present their view of the near time future of the PC revolution.

Microsoft chairman Bill Gates in particular, appeared to make a strong bid to become the industry's premier visionary, a position left vacant ever since John Sculley was removed at Apple 18 months ago.

Gates presented his vision for the year 2005, a point in time when Gates foresees computers to have become all pervasive in just about every facet of life. They come in many shapes and forms, and are capable of presenting the user with vast resources at their fingertips — or, as in Gates' vision, at their lips since most devices in the future will operate mostly on voice recognition. "I think voice recognition will become a really central way to advance the computer. We'll see speech command capabilities as well as the ability to store speech and play it back. You can see the words displayed as the person speaks."

Gates spoke before a capacity crowd of more than 7000 people, and used a motion picture quality video to illustrate different parts of his vision. The story in the video revolved around two detectives solving the murder of an art smuggler, and a high school student creating a multimedia report for a homework assignment. Along the way, the video showed how personal computers will show up as 'electronic wallets', on wall displays in the kitchen, on our living room walls for art display, on dashboards in our automobiles, in class rooms, and even in pay telephones.

By 2005, Gates said "these devices will be pervasive. Everybody will be using them, and the critical mass of information will be there," adding that the basic technology to realise Gates' vision "already exists today in some form and is simply waiting to be improved and put into place."

Not surprisingly, in Gates' vision, computing in 2005 is standardised on the Windows user interface. Gates made no secret of his plans for Microsoft in the future market place by creating the standards for information to be packaged, and sent among computers. "You need to have a common architecture," he said.

In Gates' information society, wallet size computers will replace pay phones and automatic teller machines. They will allow people to pay with 'virtual cash' by punching a few buttons to 'shuffle' electronic money from their wallet into the electronic register of a retailer. They will also replace credit cards, cellular phones, pagers, metal car and house keys, and paper photos of the kids.

Observers pointed out several seemingly disturbing facets of Gates' view, particularly the wealth of information instantly available on individuals and businesses with only a phone number as the password. Information ranging from financial transactions to detailed medical records, to criminal records.

Gates said some of these issues, notably privacy and access for the poor, would have to be dealt with by politicians as much as by technologists. "You need to use both technology and policy to make sure people are confident enough to use the information superhighway for all their activities," he said of privacy.

And, he said, computer makers also must make all the information this future promises easy to use by individuals who are often afraid of technology. "That's a challenge to the industry," he said.

CPU based multimedia

Meanwhile, the man who will be providing the building blocks for Gates' Vision, Intel's Andy Grove, returned to Comdex to update his company's future. Grove's vision was only two to three years out into the future, and focused on the evolving PC platform. His presentation centred around the first public demonstration of the concept of 'Native Digital Processing' (NDP) in which the PC's CPU, with the help of only software, takes over virtually all multimedia functions, eliminating the need for a multitude of video, audio, graphics and other add-in cards.

In the demo, Grove linked himself up with two Intel factories in Santa Clara and Ireland, and showed a video conference call in which two managers at each end discussed a manufacturing problem, and shared key documents on which each pencilled in remarks to illustrate arguments.

While Grove's vision would spell doom for much of the multimedia add-in board industry, Grove said it is imperative that the CPU takes command of most multimedia and communications functions ahead of the arrival of the information superhighways, which will add a vast amount of multimedia demands on the system — demands which cannot be effectively and economically handled with separate pieces of equipment.

Grove showed a slide of the back of a common networked multimedia PC, featuring no less than 16 connectors to and from seven add-in cards and various other devices, essential to enable today's PC to perform multimedia operation.

The move towards all-software-based Native processing will not only make things simpler, it will allow the cost of multimedia computing to come down dramatically. With NDP every PC becomes a video teleconference capable station, with the addition of just the software and a video camera and microphone.

Gates unveils 'Marvel'

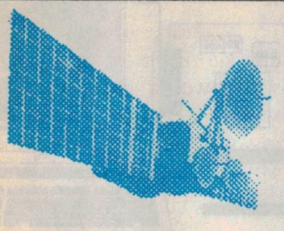
During a press luncheon at Comdex Bill Gates also demonstrated the on-line network his company has been developing under the code name 'Marvel'.

When officially launched the service will be known as 'The Microsoft Network' and will be bundled with every copy of Windows 95, a move that has raised outcries of unfair competition among existing on-line service providers.

Almost with a single click of the mouse, millions of PC users will instantly become subscribers to the Microsoft Network, which will be made available in 35 countries and in 20 languages. The network could have as many as 20 million users by the end of 1995 — 10 to 20 times the subscriber base of each of the three largest existing services (CompuServe, America Online and Prodigy).

Gates, however, denied the Microsoft service is anti-competitive, saying users still must elect to subscribe. And he argued that competitors could reach agreements with other computer manufacturers. "The key question is growth of the market. It's now a very poor business," he said, referring to the low percentage of computer users who subscribe to on-line services. While 40% of today's Windows users have modems, only 10% subscribe to any on-line service. "That's a huge opportunity for content providers," Gates said.

The Microsoft Network will also be dramatically different from existing on-line services in the way people will pay for its use. Unlike current services which charge users hourly and monthly fees, Microsoft Network users will be charged for what they purchase — whether it is a newspaper article, stock quotes, a sweater at an electronic boutique. The Network, Gates said, "will act as a platform for independent content and service providers, who will offer their own pricing options." ❖



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READER INFO NO. 27

PC DIAGNOSTICS MADE EASY

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With PC Probe™ you'll save time and money when your PC starts acting up. In one easy-to-use package you get Diagnostics, Virus Protection (for over 700+ known viruses), Benchmarks (including the famous LandMark System Speed Test™), Performance Enhancement Utilities, and System Information. Combined, this arsenal of tools will keep your system up and running at peak performance and remove the mystery about what's inside.

PC Probe diagnostic testing quickly isolates the source of hardware problems, even locating bad RAM chips. It tests system board, RAM, video, keyboard, com ports, floppy and hard drives, Ethernet card and more. Run PC Probe tests in batch mode or single pass, remote or on-site.

THE 5 MINUTE SOLUTION TO FLOPPY DRIVE FAILURE

With **Alignit™** you can *clean, diagnose, and align* your floppy drives in minutes *without* a scope. Patented technology requires only screwdriver to perform ANSI-accurate alignments (.3 mil).

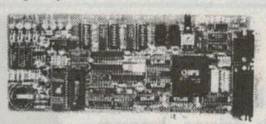
Alignit is *ideal for corporate users with* 2 or more PCs because it includes a "**GOLD STANDARD**" feature so you can align all your PCs to the same in-house standard, *guaranteeing that all your floppies are perfectly interchangeable* between PCs.

80% of all floppy drive failures can be fixed with Alignit so don't replace your drive, save time and money instead. Includes dual size floppies, (both high and low density) and no-mess pre-lubricated cleaning diskettes (both sizes) good for 180 uses. Replacements and single drive size versions available. For al PCs and compatibles.

PC WON'T BOOT? THEN JUST KICKSTART IT!

Don't replace your motherboard, don't call service, use **KickStart 2™**. When serious hardware problems occur, nothing gets you up and running as fast. KickStart 2 *measures power within 2.5%* on all four voltages, *shows Power-On Self-Test* (POST) failure codes, and features *on-board ROM-based diagnostics* allowing you to *determine and remedy the problem quickly, easily, and inexpensively!*

Built-in serial and parallel I/O *allows for testing via modem,* or simply logging results to a remote terminal, printer or laptop. You can configure your own test routines and store them in KickStart 2's battery backed-up CMOS RAM saving valuable setup time. Includes serial and parallel loopback plugs and Landmark JumpStart AT ROM BIOS for testing PCs that don't issue POST codes. KickStart 2 *tests your system regardless of O/S (even UNIX).*



On-board switches, LEDs, and digital displays allow complete control over testing in systems lacking video or disk (ideal for motherboard or system burn-in).

Kick Start 2 is the *ultimate SECURITY CARD* too! With both supervisor and user levels of password protection, you can prevent unauthorised use of your PC and accidental running of destructive tests.

HARD CORE TESTING FOR PROFESSIONALS

Landmark/SuperSoft **Service Diagnostics**$_{TN}$ is ideal for professionals requiring the *most exhaustive diagnostic* test capabilities. Each module is CPU specific, including PC, XT, AT, 386/486, and PS/2. Since 1981 major manufacturers like Wang, Xerox, Prime, Sony, DEC, NEC, and NCR have relied on Service Diagnostics to tackle their tougest operating problems.

Intended for professional service and repair technicians, Service Diagnostics is also *easy to use* for the novice. Clear, concise on-line help and intuitive menus make finding system problems a breeze. Tests all CPUs, math chips, all memory, floppy, fixed and non-standard disk drives, standard/non-standard printers, system board, video, com ports and all keyboards. Utilities include low-level reformat, log bad sectors, edit bad sector table; the partition editor allows you to set up multiple partitions; *back-up program* transfers hard disk image on unformatted floppies and allows for *restore* after reformat.

Ideal for UNIX and other operating systems, the *self-booting version* doesn't require DOS. The manual offers troubleshooting tips to the component level. Also available in a complete Kit including; all CPU specific software, dual size floppy alignment software (see Alignit), and PC/XT & AT ROM POSTs. ***Winner of the PC Magazine Editor's Choice Award in August 1990.***

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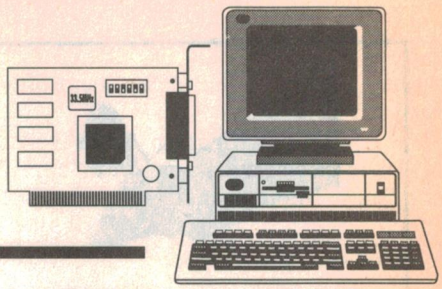
READER INFO NO. 28

Computer News and New Products



Scanning computer has RF comms

A versatile, lightweight handheld computer that integrates laser scanning and spread spectrum communications in a single unit is now available from Telxon Australia.

The ergonomically designed, battery powered model PTC-912 employs dual CPUs for optimum performance, one for terminal processing and the other dedicated exclusively to RF data communications.

The widely spaced upper numeric keys of the PTC-912 are separated from the alpha pad, enabling easy, single handed use in a typical numeric application. Barcodes can be scanned automatically via object sense logic or by triggering the left or right handed 'scan' button.

The computer is sealed against dust and moisture and is powered by a removable NiCad battery pack with built-in charging circuitry. The units are equipped with Telxon's new 095 spread spectrum radio, which provides clear, interference free data communications on a dedicated network.

Also available as a scanner only, without the RF facilities, the unit can be upgraded to an RF unit at any time. Laser scanner options include standard and medium range. The standard range version with object sense operates from 50.8mm to 508mm. The medium range scanner is capable of reading from 127mm to 1524mm.

For further information circle 162 on the reader service coupon or contact Telxon Australia, 4 Cambridge Street, Epping 2121; phone (02) 876 7222.

CD-R formatting software updated

Version 3.0 of Elektroson's Gear for Windows is claimed to be the fastest formatting software for CD-R.

Gear 3.0 can create a complete 650MB CD image in under 15 minutes, in a package that can handle more than 100,000 files and directories.

The software is claimed to be the most advanced method for the production of compact discs. Elektroson provides the software to control CD publishing, premastering, and CD writing. The multisession functionality creates enormous possiblities in document archiving, cataloging, and incremental storage requirements.

Gear 3.0 also breaks out of ISO 9660 conventions, its optimised directory and file structure handling allows formatting above ISO standards. This allows file names of up to 31 characters, and allows nesting of up to 12 directories instead of the standard eight under ISO.

For further information circle 163 on the reader service coupon or contact SCSI Corporation, P.O. Box 6888, Baulkham Hills 2153; phone (02) 894 6033.

PCB design software update

P-CAD Master Designer 8.0 is the latest release of a family of printed circuit board (PCB) design packages, which operate under DOS, Windows and UNIX environments.

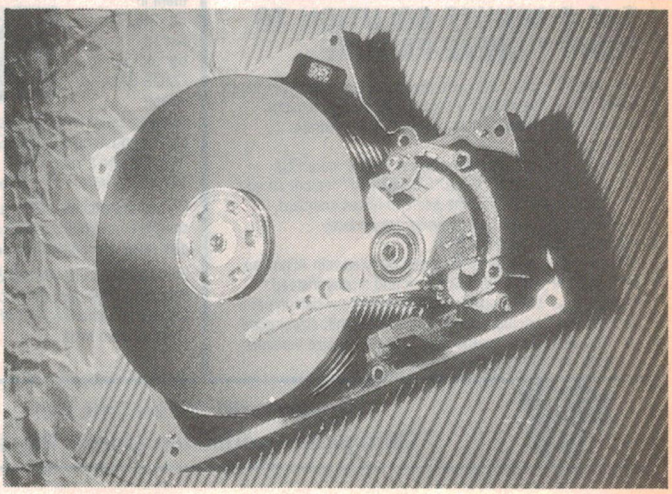
The software has an improved working environment, more flexibility, and multiple enhancements including enhanced macro facilities, expanded

4.2GB HDD's for SPARC servers

Graphics Computer Systems has available SPARC Scorpion servers with 4.2GB 3.5-inch Seagate hard disk drives, known as Hawk-4s. These drives offer nine millisecond access time and suit fast SCSI-2 controllers and fast, wide differential SCSI-2 controllers.

This product is claimed by its manufacturer to be released at least six months ahead of its opposition and will suit users running resource hungry applications on SPARC based hardware who require additional performance now. The drivers are also available in GCS RAID configurations for sites where non-stop performance and speed of access is an issue.

A single ended fast SCSI-2 drive has a recommended retail price of $5000. For further information circle 161 on the reader service coupon or contact Graphics Computer Systems, 22 Harker Street, Burwood 3125; phone (03) 888 8522.



libraries, and automatic installation of Master Designer for use under Microsoft Windows 3.1.

For further information circle 164 on the reader service coupon or contact Quest International Computer, 5 Rocco Drive, Scoresby 3179; phone (03) 763 8555.

Frequency synthesisers

Capable of ultra-wide band frequency synthesis, the FSC-30 and 50 are half-length cards for any PC-XT/AT/386 that provide up to two independent TTL level programmable square wave generators.

Both models come with one or two crystal controlled synthesisers per card, with each channel independent from the other. An optional external reference input is also available.

Software supplied with the cards provides either command line or pop-up menu selection of output frequency. Driver software is also supplied, with source code, for writing custom programs. An example program is included.

The FSC-30 has a range of 0.024Hz to 30MHz while the FSC-50 has a range of 2.98Hz to 50MHz, with a resolution of 27,000 steps per decade. The cards have three switchable addresses, for multiple card use, and are connected via 50-ohm coax with BNC connectors.

For further information, circle 166 on the reader service coupon or contact Boston Technology, PO Box 1750, North Sydney, 2060; phone (02) 955 4765.

Computerised data conversion

A new generation of compact microprocessor based speed measurement and switching instruments from Electromark provide information on three levels: a speed proportional current or voltage signal; up to four relay outputs with individually adjus-

A3 laser printer with fax/modem

The Typhoon 20 is a RISC based 20 page per minute PostScript level 2 network laser printer with a new high speed controller, PCL5+ emulation, resource accounting and enhanced edge printing.

It is also the first printer to incorporate Dataproducts' new virtual printer technology (VPT) version 3.0.

The printer's PostScript fax/modem options turn the Typhoon 20 into a fax machine or modem. Faxes up to A3 size can be sent or received including spreadsheets, architectural drawings and engineering schematics at up to 800 x 800dpi. Since the Typhoon 20 is networkable, there is no need to purchase and install fax boards, fax lines and fax modems for everyone on the network.

Rated at 50,000 pages per month, the machine prints at 300, 400, 600 or 800dpi in normal modes and 300E or 400E (enhanced edge technology) modes using DpTek's TrueRes technology. This enhanced edge printing feature improves curves and smooths jagged edges without reducing printer speed.

The printer supports all standard paper sizes up to A3 (297 x 420mm). Eight megabytes of memory are included and may be expanded up to 72 megabytes to meet the demands of any graphic applications in the market.

Typhoon 20 pricing will start at around $7000 (including tax).

For further information circle 165 on the reader service coupon or contact Dataproducts, 10 Rodborough Road, Frenchs Forest 2086; phone (02) 451 3533.

table input or output points; and an RS-232 interface for data input and output.

The frequency/current converter and the combined converter/frequency relay instruments can measure variables as a function of time, such as rotational speed, linear speed and clock rates, which can be converted to a proportional frequency by the appropriate pulse sensors.

All the operating parameters can be configured locally from an integrated microterminal. Calibration is not required. All inputs can be protected against interference or tampering by any unauthorised person. All the instruments in this range are installed in a plastic housing for mounting on tophat rails or mounting plate to DIN standard, and come provided with clip covers. The products have an accuracy of 0.2% at 12-bit resolution.

For further information circle 167 on the reader service coupon or contact Electromark, PO Box 134, Mortdale 2223; phone (02) 533 3322.

Computer controlled robotics kit

Fischertechnik has released a new robotic construction kit for use with the IBM-PC, PS/2, Amiga and Atari computers.

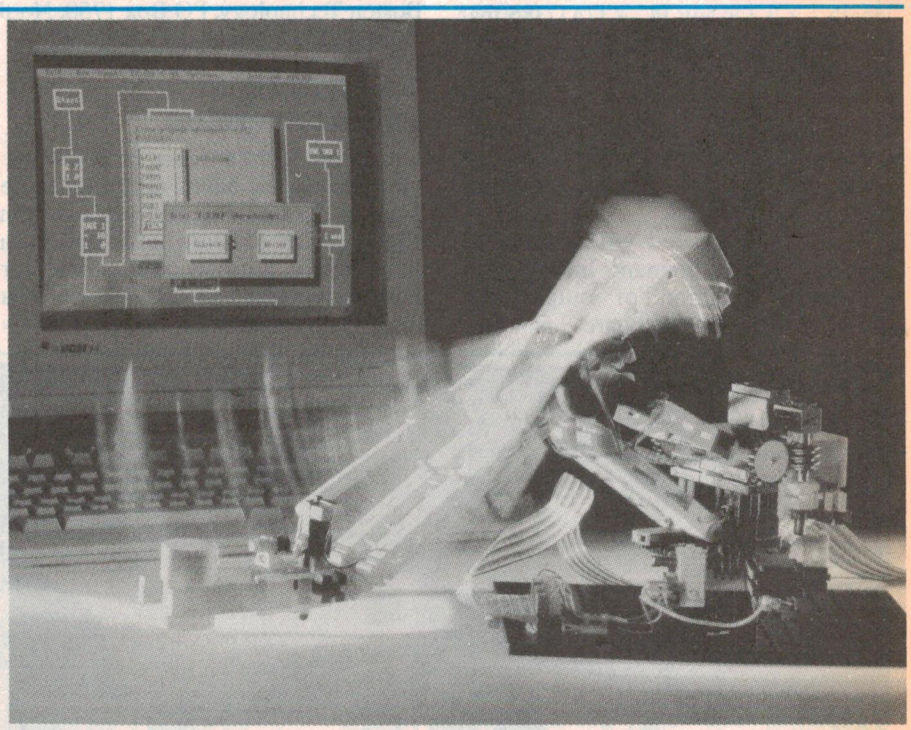
Called Profi Computing, the kit provides 888 parts with a 164-page manual describing the construction of 12 computer-controlled models. These models include a cash dispenser, plotter, CD player, parcel-turning machine and a robot with a motor driven gripper.

The kit is useful for educational and training purposes in the field of computer control, factory automation, mechanical and electrical engineering.

The interface unit provides eight digital inputs, two analog inputs and four bi-directional motor outputs. The unit connects to any parallel printer port and allows a second unit to be connected for a total of 16 digital inputs and eight motor outputs (or 16 lamp outputs).

The analog inputs can be used with potentiometers (for position control), light dependent resistors (for measuring light), thermistors (for measuring temperature) or any resistive device between 0 and 5000 ohms.

The software, called Lucky Logic, provides an interactive, mouse-driven, user interface that is similar to a sequential flow chart (SFC) style of control that is used by major industrial equipment suppliers such as Allen Bradley.



Also available is a programmable control language, PLC, developed by Procon Technology, that simulates the operation of relay-ladder-logic control. Finally, example programs are also available in C, BASIC and Pascal.

The Profi Computing kit includes three motors and gears, six microswitches, two photo-transistors, a 20-pin connection socket and construction base-plate.

For further information circle 168 on the reader service coupon or contact Procon Technology, PO Box 655, Mount Waverley 3149; phone (03) 807 5660. ❖

The Complete Semiconductor Listing – Part 5!

We started this listing back in October. in response to your many requests. We suggest you cut this ad out or photocopy for future reference!

Transistors (N=NPN, P=PNP, F=FET)

2N2644	N Dual TO78 45V 30mA	$4.35
2N2904	P TO39 40V 600mA	$1.00
2N2905A	N TO39 60V 600mA	$1.10
2N3019	N TO39 80V 1A	$1.30
2N3053	N 40V 150mA Amp	$0.50
2N3069		$1.00
2N3440	N TO39 250V 1A	$1.45
2N3460		$3.90
2N3719		$1.30
2N3740	P TO66 60V 4A	$9.70
2N3771	N TO3 40V 30A	$6.45
2N3772	N TO3 60V 20A	$6.25
2N3829	P TO92 30V	$3.75
2N3903	N TO92 40V 100mA	$0.20
2N3904	N TO92 60V 100mA	$0.25
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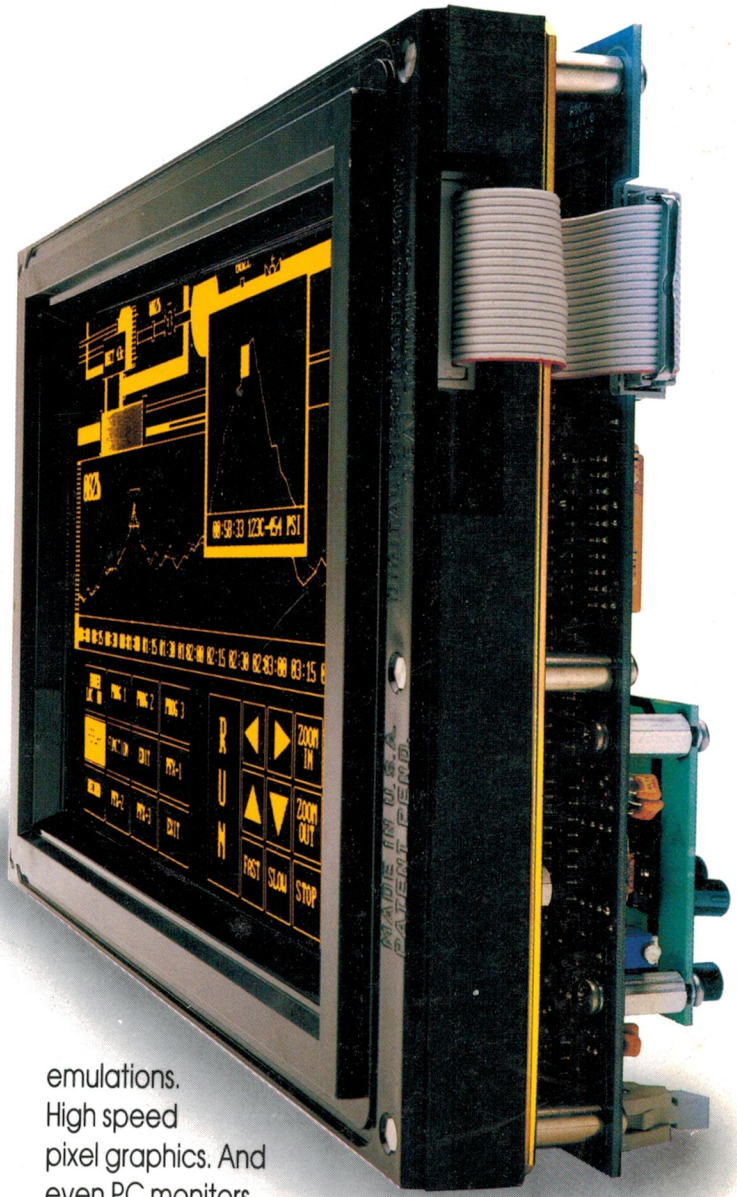

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